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THESIS

SASEBO, A CASE STUDY IN OPTIMIZING OFFICIAL VEHICLES

by

Amy Evangelista

December 2012

Thesis Advisor:	Susan K. Heath
Second Reader:	John Khawam

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SASEBO, A CASE STUDY IN OPTIMIZING OFFICIAL VEHICLES

Amy Evangelista
Lieutenant Commander, United States Navy
B.A., Tulane University, 1999

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December 2012

Author: Amy Evangelista

Approved by: Susan K. Heath
               Thesis Advisor

               John Khawam
               Second Reader

               William Gates, Dean
               Graduate School of Business and Public Policy

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LIST OF ACRONYMS AND ABBREVIATIONS

ADPS	Automated Data Processing Systems
BSVE	Base Support Vehicles & Equipment
CASE/MIS	Construction, Automotive and Specialized Equipment Management Information System
CBO	Congressional Budget Office
CESE	Civil Engineering Support Equipment
CESO	Civil Engineer Support Office
CFAS	Commander Fleet Activities Sasebo
CFAY	Commander Fleet Activities Yokosuka
CNI	Commander Naval Installation
CNIC	Commander Naval Installations Command
CNO	Chief of Naval Operation
COA	Courses of Action
COBRA	Consolidated Omnibus Budget Reconciliation Act
COL	Common Output Level
COMNAVFACENGCOM	Commander, Naval Facilities Engineering Command
CONUS	Contiguous United States
CRS	Congressional Research Service
DoD	Department of Defense
DON	Department of the Navy
FAST	Federal Automotive Statistical Tool
FEC	Facilities Engineering Center
FLC	Fleet Logistics Center
GAO	General Accounting Office
GAO	Government Accountability Office
GSA	General Services Administration
GVWR	Gross Vehicle Weight Rating
IO	Inventory Objective
IPT	Integrate Program Team
LAN	Local Area Network
MOMAU	Mobile Mine Assembly Units

NAF	Naval Air Facility
NAS	Naval Audit Service
NAVFAC	Naval Facilities Engineering Command
NFS	Naval Facilities System
NMC	Navy Munitions Command
NMCI	Navy/Marine Corp Intranet
O&M	Operations and Maintenance
OM	Objective Matrix
OMB	Office of Management and Budget
PCV	Passenger Carrying Vehicles
PD	Program Directors
PLMO	Product Line Management Office
PWO	Public Works Office
RHD	Right Hand Drive
SRF-JRMC	Ship Repair Facility—Japan Regional Maintenance Center
TEMC	Transportation Equipment Management Centers
TRIO	Transportation Review of Inventory Objectives
TYCOM	Type Commander
VAM	Vehicle Allocation Methodology

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I. INTRODUCTION

This thesis investigates how the application of an optimization model helps in the decision-making process of determining the aggregate number of vehicles at Commander Fleet Activities Sasebo, Japan (CFAS). Vehicle management has undergone changes in the past that have resulted in the current method of how the aggregate number of vehicles are determined but there is interest in whether an optimization model can be developed to see if new opportunities for improvement exist.

A. PURPOSE OF THE STUDY

The purpose of this study is to analyze Naval Facilities Engineering Command's (NAVFAC's) Public Works annual baseline assessment of administrative vehicles (also known as non-tactical vehicles) using the Public Works Office (PWO) at CFAS as the case study subject. NAVFAC's Public Works baseline assessment of administrative vehicles has traditionally been performed using a standard triennial review conducted by the echelon III command; in Sasebo's case, it is NAVFAC Pearl Harbor. While this standard has apparent adequacy at first glance, the author considered applying an optimization model to determine if a quantitative process improvement could be achieved. She, therefore, approached PWO, CFAS as the case study. The purpose of the study was to determine if transitioning to an optimization model would be cost effective, efficient, and produce a value added decision-making component for the number of vehicles. Ultimately, she wanted to see how the results would change if a different analytical or management technique was applied to an ongoing operation that has not yet been exposed to the analysis of an optimization model.

B. RESEARCH QUESTION

Every three years, CFAS undergoes a triennial baseline assessment of allowances on vehicles called a Transportation Review of Inventory Objectives (TRIO), which establishes an allowance for each vehicle (an Inventory Objective or IO). Using this baseline analysis and the resulting IOs, CFAS then uses a factor called a COL (Common

Output Level) Standard to determine how to operate its vehicle pools. The COL Standard pertains to both the funding level for vehicles and the allowed number of vehicles in relation to the IOs established by the TRIO. As stated in Army documentation, "COLs are output or performance level standards intended to create common language and toolsets for delivery of installation support applicable in a host-tenant relationship. COLs use a common framework of definitions, outputs, output performance metrics and cost drivers for each support function."[1] The "COL is meant to assist in apportioning and managing limited resources by providing a description of the capability associated with the particular installation support function;"[2] using COL results in the ability to offer "options for decision making in funding process, provide customers with realistic expectations of service delivery, and provide objective performance metrics to manage the program during execution."[3] (Elucidation of how the COL computations are done is explained in greater detail in Chapter IV) The focus of this project is to research how, given individual vehicle cost and total budget, CFAS can maximize the aggregate number of on-hand vehicles, while staying at or below the TRIO established allowance and achieving an overall aggregate COL score of 4.99 or lower to maintain the required COL 4 status. The author was also curious as to how significant of an impact the CNIC weighting factors make, if the same effect, a COL 4, can be attained using a different set of weighting factors. Therefore, this research focuses on the goal of maximizing the aggregate number of vehicles with the intent of achieving a COL 4 level.

C.   RESEARCH SCOPE

The author looked solely at "B" Pool Vehicles for the optimization since these vehicles were not only requested, but also because they are the largest parts of the inventories. As several different tenant commands have "B" pool vehicles assigned to

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[1] U.S. Army Installation Management Agency, "Common Levels of Support (CLS) Glossary (Updated 01/06/06)," 2, (n.d.), http://www.ima.army.mil/southeast/sites/divisions/documents/CLS_Glossary.doc.

[2] NAVSUP, *Transitions Joint Basing Newsletter*, Issue 2, 4, August 2009, https://www.navsup.navy.mil/navsup/ourteam/navsupgls/navsupflcph/command_activities/jbphh/Transitions-2_14Aug09.pdf.

[3] MWR, "Library MWR Program, Standards and Metrics," Intro–5, August 2005, http://navymwr.org/mwrprgms/librarystandards.pdf.

them, the proof of concept for the model was attained through the Navy Munitions Command (NMC) at Sasebo Courses of Action (COAs) that were previously analyzed locally in Sasebo.

Identical to what Kurt and Sonmezocak (2008) stated as their research scope, the following areas were also included in this research scope as well. Those areas identified by Kurt and Sonmezocak (2008) and used are as follows:

- Define key terms and concepts;
- Define the assumptions and identify the problem;
- Develop an appropriate solution method for the problem,
- Compare the results of the new solution method with the results of the existing heuristic method,
- Give recommendations (for further study). [4]

D.   METHODOLOGY

Historical data was collected to determine the information for the basic parameters of the model. Historical vehicle inventories for the months of January 2011 through November 2011, as well as budgetary information for PWO Sasebo for the current and prior two fiscal years, were collected. Additionally, literature studies pertaining to administrative vehicles, baseline assessments, and important private industry practices pertaining to improving efficiency in motor pools were reviewed, as well as the results of the most recent TRIO conducted in 2010 at Sasebo. Reports from the Government Accountability Office (GAO), Naval Audit Service, Congressional Budget Office (CBO), and Congressional Research Service (CRS) were analyzed with an additional in-depth review of Department of Defense (DoD) Directives and Publications, and other documents including NPS theses.

In this project, historical data obtained from the CFAS inventories, as well as the COL level and score calculation procedures, is translated into an Excel optimization model to maximize the aggregate number of vehicles. Several variations of the model are

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[4] Senol Kurt and Erkan Sonmezocak, "Optimal Route Planning and Scheduling for Unmanned Aerial Vehicles," 5, December 2008, http://hdl.handle.net/10945/3831.

also developed. The first model was developed as a proof of concept using a COL of 4, while maximizing the number of vehicles. The other variations were developed to minimize the costs with a COL of 4 and different levels of the total number of vehicles.

E.   ENVIRONMENT

Geographical limitations associated with separate operating Local Area Networks (LANs) in the Far East and continental United States presented a challenge for computer tool usage. Given Department of the Navy (DON) contractual limitations with Navy/Marine Corp Intranet (NMCI) used in the United States, and OneNet used in the Far East, the model developed and discussed was designed and built in Microsoft Office Excel using Solver for optimization.

F.   ASSUMPTIONS

The primary assumption for the methodology development was that the data that resulted from the optimization model would be simple to interpret. Additionally, throughout the thesis and study, the author made some assumptions that became necessary due to lack of data to support a prior existing analysis. Specific assumptions are discussed in the data analysis as they arise. This analysis assumes familiarity with optimization and a basic understanding of modeling.

G.   ORGANIZATION

This thesis is divided into seven chapters. Chapter II covers background and a review of literature used to develop the study. Chapter III discusses the TRIO, its background and current state. Chapter IV includes background information regarding Sasebo. Chapter V discusses the model, including formulation, challenges, assumption, inputs, and implementation. Chapter VI presents the findings and results of the study, and Chapter VII provides a summary and suggestions for further research.

II.   BACKGROUND

To gain a common level of understand, it is necessary to provide some basic background on some commonly used terms and their definitions, the governing instructions for vehicles, some background on the current budgetary issues that the DoD is facing and the implications of those issues. Definitions covered include classes of vehicles, COL, IT Systems, and some terms common to vehicle management. Future chapters, Chapters III and IV, cover the TRIO itself and Sasebo, respectively.

A.   DEFINITIONS

The following are key conceptual and operational terms that must be defined to give the reader a better grasp and understanding of language specific to this study.

1.   Types of Vehicle Pools

a.   *"A" Pool Vehicles*

"A" Pool vehicles are vehicles that have continuing assignments. For Navy purposes, a Class "A" assignment is defined as "the full-time assignment of a specific nonstandard vehicle (i.e., midsize/large sedan or command and control vehicle) to an individual billet."[5] With the exception of Class IV and Executive vehicles, "Class A assignments must be made individually. Requests for these assignments shall be forwarded to CNO for approval, via the command chain and the responsible TEMC with a copy to NAVFAC (Code PWT)."[6] Class A vehicles include the following:

- Class IV (Large) Sedan Assignments
- Class III (Midsize) Sedan Assignments
- Command and Control Vehicle Assignments
- Executive Vehicles

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[5] NAVFAC P-300, "Management of Civil Engineering Support Equipment," Paragraph 2.1.2.b, 2-2–2-3, September 2003, https://portal.navfac.navy.mil/portal/page/portal/docs/doc_store_pub/p-300.pdf.

[6] Ibid.

b.   *"B" Pool Vehicles*

"B" Pool vehicles are vehicles that are "recurring dispatch assignments."[7] According to the NAVFAC P-300, the assignment of "B" Pool vehicle,

> …must be authorized in writing by the local Commander, to an organizational unit or tenant activity of the Command on a regular or continuous basis for the conduct of official business. Commanding Officers can restrict the use of a Class B assignment to an individual billet or to expand its uses to meet changing requirements within the organization. A Class B assignment should be considered when requirements cannot be met by use of "C" pool equipment, other types of available transportation, or is shown to be the most cost effective alternative.[8]

c.   *"C" Pool Vehicles*

"C" Pool vehicles are "all DoD motor vehicles not designated as Class A or B assignments and shall be pooled for performance of services on an on-call basis."[9] Vehicles assigned to designated shore activities are a special category of "C" Pool vehicles assigned on a priority basis. Vehicular support for ships and afloat commands is provided from class C pools and are funded by the Commanders, Atlantic Fleet or Pacific Fleet.[10, 11]

2.   COLS (Common Output Level Standards)

COLS, as stated in Common Levels of Support document are,

> …output or performance level standards that were established and adopted throughout the DoD in 2005 through an initiative with the intent to create common language and toolsets for common delivery of installations support applicable across all U.S. military installations in a host-tenant

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[7] NAVFAC P-300, "Management of Civil Engineering Support Equipment," Paragraph 2.1.2.b, 2-2–2-3

[8] Ibid.

[9] Ibid., Paragraph 2.1.2.c, 2–3.

[10] CINCLANTFLTINST 11240.3 and CINCPACFLTINST 11200.3, provide guidance and direction regarding automotive vehicles and equipment inventory objectives for ships and afloat commands in the Atlantic and Pacific Ocean areas, respectively.

[11] NAVFAC P-300, "Management of Civil Engineering Support Equipment," Paragraph 2.1.4, 2–4.

relationship. COLS use a common framework of definitions, outputs, output performance metrics and cost drivers for each installation support function.[12]

Ultimately, the framework COLS is "meant to assist in allocating and overseeing limited resources by providing a description of the capability associated with the particular installation and function which that capability supports."[13]

For the purposes of this thesis, it is a

…four level system for describing Navy's delivery of Shore Services and Support services. Specific COL Standards for individual business areas are developed by subject matter experts on Integrate Program Teams (IPTs) and provide support to the Commander Naval Installation's (CNI) Program Directors (PDs).[14]

Additionally, COLS are a

…cornerstone of CNI and OPNAV's ability to program, budget and execute in a consistent/logical manner and provide capability and cost options to leadership for decision making in programming and budgeting. COL Standards are program centric and "standard" across all regions. It is imperative that COL Standards are distinct options that are price-able, measurable, output oriented and viable.

COL Standards offer options for decision making in the funding process, provide customers with realistic expectations of service delivery, and provide objective performance metrics to manage the program during execution. Defined COL Standards assist greatly with tracking and communication of performance and with the identification of resource requirements and are supported by numerous performance metrics that are consistent with, but more detailed than, the COL Standards themselves. These supporting performance metrics are cataloged in a specialized weighted spreadsheet called an "Objective Matrix "(OM)."[15]

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[12] U.S. Army Installation Management Agency, "Common Levels of Support (CLS) Glossary (Updated 01/06/06)," 2.

[13] NAVSUP, *Transitions Joint Basing Newsletter*, 4.

[14] MWR, "Library MWR Program, Standards and Metrics," Intro–4.

[15] Ibid.

COLS in NAVFAC, descending in percentage of IOs filled, are the following.

- COL 1
- COL 2
- COL 3
- COL 4

COL 4 is the crux of this research as it drives the business practices at the current time throughout all NAVFACs regardless of location; all NAVFACs, with regard to vehicles pools, are mandated to operate at COL 4, which is the most important parameter in the model.

In reviewing all the collective material for COL, the author found the definition of COL 4 to be the most subjective, as no one solid, aggregate description exists, but is, rather a range of what COL 4 is based on, the comprehensive priority level of the vehicles. The rainbow chart for all COLs as determined by and promulgated through Commander Naval Installations Command (CNIC) is shown in Appendix A. Throughout the rest of this thesis, COL 4 will refer to a funding rate, an allowance fill rate, and a service level provided of less than 67 %.

3. TRIO

The TRIO is a triennial baseline assessment of allowances on vehicles, a fleet management tool. The TRIO is a process that occurs every three years and serves to baseline the vehicles in the "B" and "C" pools at installations; a TRIO will occur every three years for each installation. The TRIO consists of a three-step process and each step has a series of associated procedures that occur. Additionally, each step has certain resources associated with it. These steps are further discussed in Chapter III.

4. Inventory Objective (IO)

IO is an allowance for a vehicle. The TRIO determines the IOs during the triennial review. The aggregate IOs gives not only the maximum number of vehicles for the command, to include tenant commands, but also the aggregate number of vehicles by

type; it is possible to have an IO but not have that IO filled. If no IO is provided for a specific vehicle or for a command, then a vehicle is not authorized.

5. CESE (Civil Engineering Support Equipment)

Civil Engineering Support Equipment (CESE) is a collective term intended to "reference automotive vehicles, construction, and railway equipment."[16]

6. CASE/MIS

Construction, Automotive and Specialized Equipment Management Information System (CASE/MIS) is a computer program used for management and procurement of all CESE, maintained by the Civil Engineer Support Office (CESO), Port Hueneme, which enables the Atlantic/ Pacific (LANT/PAC) equipment offices to perform on-hands management of CESE assignment, replacement, overhaul, and disposal.[17] Simmons also stated that this "automated system separates activities by claimant and reports on the size of their vehicle fleets as well as the general composition of the fleets."[18] Thus, as Cyr states CASE/MIS "is a comprehensive equipment management information system developed by NAVFAC to assist in the management of the U.S. Navy's total inventory of construction, automotive, and special equipment. The CASE/MIS is part of the Naval Facilities System (NFS) Automated Data Processing Systems (ADPS)."[19]

7. Public Works Department

The Public Works Department, run by the PWO, is an entity within a host installation, which it serves. The department is responsible for providing both "B" and "C" pool vehicles to departments/shops and tenant commands. Additionally, as the Naval

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[16] NAVFAC P-300, "Management of Civil Engineering Support Equipment," Paragraph 1.1, 1-1.

[17] Definition provided by PWO Sasebo, e-mail message to the author, March 22, 2012.

[18] Gregory S. Simmons, "A Study of the Comparability of Naval Activity Motor Vehicle Costs" (master's thesis, Naval Postgraduate School, 1993), 24–25, http://www.dtic.mil/dtic/tr/fulltext/u2/a268900.pdf.

[19] Phillip G. Cyr, "Cost Analysis of Maintenance Programs for Pre-Positioned War Reserve Material Stock (PWRMS)" (master's thesis, Naval Postgraduate School, 2002), 5, http://www.dtic.mil/dtic/tr/fulltext/u2/a405815.pdf.

Audit Service stated in 1998, "they are responsible for management, administration, and maintenance of the vehicles under their purview."[20]

8. Federal Automotive Statistical Tool (FAST)

FAST is a tool in place to:

…simplify annual data reporting and regular monitoring of GSA Fleet vehicles. GSA Fleet's FAST Data Center provides a wide variety of reports. Available reports include vehicle inventory, vehicle cost, miles driven, acquisition and disposal expenses, and fuel consumption. These reports are accessible throughout the year, and can be used to track and manage inventory and fleet resources.[21]

B. GOVERNING INSTRUCTIONS OF MOTOR VEHICLES

Motor Vehicle Instructions cascade from GSA down to the unit/installation level. While some information clearly overlaps and is redundant, each echelon provides a more detailed application for specific vehicles and usage. These instructions provide limits and constraints to both usage and available management options; however, none of the instructions seems to force limits and constraints that cannot be accommodated using an optimization approach.

1. NAVFAC P-300, Management of Civil Engineering Support Equipment

NAVFAC P-300, Management of Civil Engineering Support Equipment, dated September 2003, is the primary NAVFAC publication on vehicle administration and management. As stated on page iii of the foreword,

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[20] Naval Audit Service Report 030-98, "Management of Non-Tactical (Administrative) Transportation Vehicles," March 24, 1998, 11.

[21] GSA, U.S. General Services Administration, "FAST Data Center," (n.d.), http://www.gsa.gov/portal/content/102677.

The purpose of this publication is to assist management, at all levels, in the efficient management of the transportation program. Instructions, guides, procedures, and criteria are provided for exercising both technical and management controls to attain full and cost effective utilization of funds, personnel, and equipment.[22]

In addition to the purposes mentioned, the P-300 also "provides general and detailed procedures for various other necessary functions such as the administration, operation, and maintenance of transportation equipment,"[23] which are also covered including but not limited to the procurement, rental, record control, disposition, and operational procedures to name only a few.

2. Department of Defense Regulation 4500.36-R

Department of Defense Regulation 4500.36-R, Management, Acquisition, and Use of Motor Vehicles, dated March 16, 2007, implements DoD Directive 4500.36. This regulation delineates authorities, responsibilities, policies, and procedures concerning DoD-owned or controlled motor vehicles and it also sets forth the policy for motor vehicles in the DoD; it is the foundation for vehicle management, procurement, and usage.[24]

3. The General Services Administration, GSA

The General Services Administration (GSA) has both a regulatory and operational role concerning motor vehicle fleets[25] that includes the compilation of FAST data.

4. OPNAV Instruction 11240.8H

OPNAV Instruction 11240.8H, assigns responsibility for the management of CESE under a single manager in the Navy and applies to the management of general

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[22] NAVFAC P-300, "Management of Civil Engineering Support Equipment," Foreword, iii.

[23] Ibid.

[24] Department of Defense Regulation 4500.36-R, Management, Acquisition, and Use of Motor Vehicles, March 16, 2007, http://www.dtic.mil/whs/directives/corres/pdf/450036r.pdf.

[25] U.S. Government Accountability Office, *Federal Motor Vehicles, Private and State Practices Can Improve Fleet Management* by William M. Hunt, (GAO/GGD-95-18), Washington, DC: GPO, 1994, 10, http://www.gao.gov/assets/160/154786.pdf.

purposed equipment, including automotive vehicles, construction, weight handling, railway, and associated types of equipment, afloat and ashore. The Commander, Naval Facilities Engineering Command (COMNAVFACENGCOM) is assigned as the single manager for CESE for the Navy.[26]

C. CURRENT FEDERAL GOVERNMENT BUDGETARY ISSUES

Fiduciary responsibility is more important than ever before. With national debt continuing to rise, and the continual reluctance to continue to raise the debt ceiling, government-wide savings are becoming paramount; and with 10 years of war that have pushed the budget and the deficit to the breaking point, it is more important than ever to evaluate and audit all cost drivers looking for savings where possible.

More specifically, budget constraints are now beginning to take the form of austere measures especially in light of across-the-board cuts looming for fiscal year 2013 resulting from political paralysis emanating from the Congressional Joint Select Committee of Deficit Reductions, informally known as the "Super Committee." As reported by the CBO on September 12, 2011:

> The Budget Control Act of 2011 (enacted on August 2 as Public Law 112-25) made several changes to federal programs and established budget enforcement mechanisms…that were estimated to reduce federal budget deficits by a total of at least $2.1 trillion over the 2012–2021 period…At least another $1.2 trillion in deficit reduction was anticipated from provisions related to a newly established Congressional Joint Select Committee on Deficit Reduction…However, if legislation originating from the committee is not enacted automatic procedures for cutting both discretionary and mandatory spending will take effect.

> The automatic reductions—if triggered—would take the form of equal cuts (in dollar terms) in defense and nondefense spending starting in fiscal year 2013.[27]

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[26] OPNAV Instruction 11240.8H, "Management of Civil Engineering Support Equipment in the Navy," Para 1 and 5, June 18, 2008, http://doni.daps.dla.mil/Directives/11000%20Facilities%20and%20Land%20Management%20Ashore/11-200%20Transportation%20Facilities,%20Heavy%20Equipment/11240.8H.pdf.

[27] Congressional Budget Office, "Estimated Impact of Automatic Budget Enforcement Procedures Specified in the Budget Control Act," September 12, 2011, 1–2.

More specifically, the CBO states,

> If none of the specified savings of $1.2 trillion was obtained through legislation originating with the deficit reduction committee, the automatic procedures would reduce budgetary resources for national defense by about $55 billion a year between 2013 and 2021 (approximately $454 billion total).[28]

These reductions would be in addition to the $500 billion in reductions that the DoD will achieve over the next 10 years from self-imposed cost-cutting measures and would be split proportionally between mandatory and discretionary defense spending. However, it is important to highlight at this time that mandatory spending comprises less than 1% of all defense spending; therefore, only approximately $150 million would be sequestered from mandatory defense programs over the 2013–2021 period. Consequently, almost all the required deficit reduction in the defense category would have to be achieved by lowering the caps on future discretionary appropriations for defense activities; vehicles fall under Operations and Maintenance (O&M) funds historically considered discretionary funds. Given the current political stratification, it is no surprise the Super Committee deadlocked on November 21, 2011 with no recommendations or legislation.

One of the biggest sources of expenses throughout the federal government and certainly also within the DoD is non-tactical vehicles,[29] referred to throughout the text as administrative vehicles. This vehicle fleet has come under renewed scrutiny within the DON and NAVFAC for consideration to right size and optimize if possible. However, the seeds of right sizing of administrative vehicle fleets can actually be found much sooner, dating back to as early as 1985.

On top of the financial crisis and lack of clear political budgetary direction, Ashton B. Carter, then Undersecretary of Defense for Acquisition, Technology and Logistics, on the eve of the start of fiscal year 2011, released a 23 point memo on better buying power within the DoD. This memo is the first detailed announcement as part and

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[28] Congressional Budget Office, "Estimated Impact of Automatic Budget Enforcement Procedures Specified in the Budget Control Act," September 12, 2011, 9.

[29] U.S. Government Accountability Office, *Federal Motor Vehicles, Private and State Practices Can Improve Fleet Management*, 2–3.

parcel of Defense Secretary Robert M. Gates' initiative, announced in August 2010, to save $100 billion over the next five years without negatively affecting warfighters.[30] While the memo pertains to acquisitions and procurement, the impacts will be felt department wide. With this, CNIC has also mandated that funding for transportation would be limited to a COL 4 level for both fiscal years 2010 and 2011, a financial trend that carried forward into fiscal year 2012.

D.   SUMMARY

As Jiminez et al. state in their thesis, "The global financial crisis, the rising U.S. national debt, and the slowing pace of funding for the wars in Iraq and Afghanistan, among other things, have resulted in declining defense budgets and significant fiscal stress for the DoD."[31] During his tenure as Undersecretary of Defense for Acquisition, Technology and Logistics, Ashton B. Carter, made two key assertions and statements: one is that we as the Department of Defense need to "…do more without more" or in essence save the taxpayer money without affecting mission readiness;[32] and two, "We need to take a comprehensive look at our spending, including, but not limited to acquisition programs."[33] Budgetary constraints were, are, and always will be, prominent in business operations and are increasingly a driver in today's environment. The next chapter provides information on the historical background that lays the foundation on how the TRIO came into being.

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[30] Lisa Daniel, "Carter Outlines Plane to Help Warfighter, Taxpayers," September 14, 2010, http://www.defense.gov/news/newsarticle.aspx?id=60852.

[31] Verbage from David A. Jiminez, Jason B. Wamsley, and Nicholas E. Priscoe, "Optimizing the Ground Mobile Radio Basis of Issue for the U.S. Army Heavy Brigade Combat Team" (MBA professional report, Naval Postgraduate School, 2011), http://edocs.nps.edu/npspubs/scholarly/MBAPR/2011/December/11Dec_Prisco_MBA.pdf.

[32] Daniel, "Carter Outlines Plane to Help Warfighter, Taxpayers."

[33] Donna Miles, "Carter: Budget Cuts Demand More DOD Buying Power," April 20, 2011, http://www.defense.gov/news/newsarticle.aspx?id=63633.

III. THE TRIO

The TRIO, which is conducted every three years, forms the baseline, and hence, the foundation on which this research builds. This study uses the TRIO established inventory objective (IO) for Sasebo as the high limit on vehicle allowance(s) when solving for the optimal numbers of vehicles. As we soon see, the TRIO combines the best of the recommendations that date back to 1985 into a process that occurs every three years and serves to baseline the vehicles in the "B" and "C" pools at each installation. The TRIO has a three-step process and each step has a series of associated procedures that occur. Additionally, each step has certain resources associated with it. To understand the TRIO, and what occurs, fully, it is first necessary to provide some historical background, as well as information about the vehicle management plan and the broad objective of the TRIO, and also describe each step starting with the overarching fleet management plan.

A. HISTORICAL BACKGROUND

To understand how the TRIO came into existence, it is necessary to understand the evolution of vehicle pools and the efforts made prior to TRIO to secure a hold on standardizing vehicle management and ensuring that installations have the appropriate number of vehicles, with no excess on hand, to meet mission requirements. This historical background dates back to 1985 and ends in 2004; no documents, reports, or studies on vehicle management could be found after the 2004 GAO report. The available historical background predates the establishment of the TRIO itself, but it seems to have been established sometime between 2009 and 2010; although the information on the establishment of the TRIO is not readily available, from later documents (such as this presidential memorandum) it appears that the TRIO was established around 2009 or 2010.

1. 1985–1995

The Consolidated Omnibus Budget Reconciliation Act (COBRA) of 1985 required agencies within the federal government to take "certain actions" to improve management, improve efficiency, and reduce costs; essentially, right size the fleet that in this case means ensuring that the right number and types of vehicles are in the fleet. It also mandated that the GSA issue regulations to execute cost-comparison requirements and the Office of Management and Budget (OMB) monitor agency compliance. In 1988, the U.S. General Accounting Office (GAO) reached out to evaluate if agencies had complied with the 1985 act. The conclusions of the GAO report were, for the most part, that of non-compliance, as most had not done required studies to determine cost-efficiency. In 1991, President George H. W. Bush set up a taskforce to identify obstacles to cost-efficiency in vehicle fleet management including a continued lack of compliance with the Budget Reconciliation Act of 1985. Based on the taskforce's recommendation, the OMB issued uniform guidance for conducting valid cost-comparison studies in 1993. The taskforce did not convene after October 1993.[34]

In 1995, the GAO, released a report entitled, *Federal Motor Vehicles, Private and State Practices Can Improve Fleet Management*, GAO/GGD-95-18, after Senator John Glenn requested an examination of federal motor vehicle fleets. At that time, the GAO estimated total expenditures for vehicles was more than $1 billion, which made the federal government the operator of one of the largest vehicle fleets in the United States.[35] It found once again that no substantial action had been taken in response to the 1985 Budget Reconciliation Act as "most federal agencies have continued to operate fleets without considering potentially more cost-efficient alternatives." From this GAO report, five key elements were identified.

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[34] U.S. Government Accountability Office, *Federal Motor Vehicles, Private and State Practices Can Improve Fleet Management*, 2–3.

[35] Ibid., 2.

(1) Obstacles to cost-efficient federal fleet management include the lack of uniform guidance for conducting valid cost-comparison studies, insufficient vehicle information, unpredictable funding, and restrictive agency solicitations that limit private-sector competition;

(2) In 1993, the Office of Management and Budget (OMB) issued uniform guidance for conducting valid cost-comparison studies in response to a task force recommendation;

(3) Most federal agencies continue to operate their fleets without complying with statutory requirements for cost-efficiency;

(4) Improving fleet management requires a cost-conscious culture; and

(5) Essential management practices for cost-effective fleet operation include:

    a)   Assessing vehicle utilization to determine the appropriate size of the fleet;

    b)   Establishing a fleet operation baseline through benchmarking;

    c)   Having needed information and supporting management information systems to assess performance;

    d)   Comparing costs and performance with the best fleets;

    e)   Funding the fleet through a revolving fund; and

    f)   Centralizing fleet management responsibilities.[36]

Element number (5) with its sub-parts is also the best practices of the private sector and can be interpreted as recommendations. It is also important to emphasize that element 5 is also what laid the foundation for the TRIO years later, but some aspects were omitted, such as (5)(d), that perhaps are relevant only to the private sector.

2.   1998 NAS Report

The next study or audit on fleet vehicles that had an impact on DON business operations occurred in 1998 when the Naval Audit Service (NAS) released its report in

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[36] U.S. Government Accountability Office, *Federal Motor Vehicles, Private and State Practices Can Improve Fleet Management*, 3.

March entitled "Management of Non-Tactical (Administrative) Transportation Vehicles," NAS 030-98. This document is one of the two referenced in the NAVFAC TRIO process steps; its influence in the TRIO's foundation is of principal importance.

This study is the only readily recoverable and researchable document available that specifically addresses vehicles in the Navy. On page three of the study, it notes a budget decrease for fiscal years 1998 through 2002 of at least $1.9 billion for shore establishments; the goal was to increase the quality of support while reducing infrastructure costs at the same time. (The "doing more with less" management lexicon was popular even at that time in DON.) On the same page, the NAS mentions the implementation of "regionalization." Regionalization is the consolidation of functions in large fleet concentration areas to "consolidate, realign, or eliminate redundant functions, activities, or tenants … to free resources and use them for Navy readiness and recapitalization;"[37] essentially, the Navy mirrored one of the key elements for the 1995 GAO report, that of centralizing fleet management responsibilities.

The methodology utilized in the Navy audit also emulated the best practices in the 1995 study; the TRIO utilizes the same parameters for its benchmarks. Specifically, the methodology used was not just DoD and Navy annual utilization goals requiring certain mileage to be driven each year, but also the actual general purpose mission of the vehicle. When the 1995 study uses *general purpose*, it is referring to whether people or supplies were moved, was it production oriented if it was a supply, did it have a special category with in the "C" pool vehicles, and/or was the vehicle disposed of with no replacement. The NAS's usage of additional parameters resulted from their acknowledgement that, should the vehicle not meet the mileage guideline, it did not necessarily mean that it was not an important asset. Therefore, other parameters should be utilized to determine whether a vehicle could be retained in inventory, acknowledging that how the vehicle

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[37] Naval Audit Service Report 030-98, "Management of Non-Tactical (Administrative) Transportation Vehicles," 3.

was employed might greatly influence the miles driven; some vehicles, i.e., cranes or trailers, are assessable via usage hours vice miles that provides a better utilization indicator.

In 1998, NAS used the CASE/MIS system to obtain the data for its audit and reviewed only vehicle alpha codes A-N. See Figure 1 for alpha codes.

Alpha Code	Description	Alpha Code	Description
A	Sedans	O	Truck, Special Purpose or Design
B	Bus-BOC 37 Pass & under	P	Trailers
C	Bus-BOC 38 Pass & over	Q	Aircraft Ground Support Equipment
D	Bus-Integral	R	Material Handling Equipment (MHE)
E	Station Wagon	S	Construction Equipment *
F	Ambulances	T	Construction Equipment **
G	Truck, ½ Ton Pickup	U	Grounds Maintenance Equipment
H	Panels- Carryall-Trk, ¼ - ¾ ton	V	Railway Cars
I	Truck & Truck Tractor, 1 Ton	W	Powered Railway Equipment
J	Truck & Trk Tractor, 1.5 –2 Ton	X	Fire Fighting Equipment
K	Truck & Trk Tractor, 2.5 Ton	Y	Weight Handling Equipment (WHE)
L	Truck & Tractor, 3 –4 Ton	Z	Miscellaneous Transportation Eq.
M	Truck & Tractor, 5 –10 Ton		
N	Truck & Trk Tractor 11 Ton & up		

Figure 1.   Navy Alpha Codes[38]

The results of the audit showed that installations had underutilized and invalid, or not needed, vehicles due to a lack of a systematic management instrument to limit the number of vehicles; 27% +/- 2.71% of vehicles sampled were found to be excess or invalid. An established motivational reason for an installation to minimize cost, pool/share vehicles, or to employ other modes of transportation, which might be more economical, did not exist. By reducing the number of excess vehicles, the savings per annum, determined in 1998, was roughly $19.8 million dollars or $119 million extrapolated out over a 6-year period.[39] The recommendations to the Deputy Chief of Naval Operations for Logistics (N4) made from the audit were as follows:

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[38] NAVFAC P-300, "Management of Civil Engineering Support Equipment," 3–15.

[39] Naval Audit Service Report 030-98, "Management of Non-Tactical (Administrative) Transportation Vehicles," 12–15.

a.　Coordinate and/or direct major claimants, regional commanders, and installation commanders to review and rejustify all administrative vehicles (Alpha Codes A through N) using the DoD mileage standards or other documented alternative measurement criteria to justify vehicle retention.

b.　Coordinate and/or direct the Transportation Equipment Management Centers (TEMCs) to redistribute those vehicles identified through Recommendation 1 as not justified or needed to where vehicles are needed, dispose of over-aged and unneeded vehicles, and delete the inventory objective associated with these vehicles to avoid future procurements.

c.　Centralize the vehicle transportation management function into a single process under regional commanders and/or host installation management claimants to include a validation unit and a vehicle supplier, and develop a regional transportation program that: (1) validates the requirement for all Class B assignments based on regional policy; (2) maximizes the utilization of Class C pool assignments and bus/taxi services; and (3) focuses on reducing administrative transportation costs.[40]

It should be noted that Chief of Naval Operation (CNO) N4 concurred with the NAS recommendations and potential monetary benefits.[41]

3.　2004 GAO Report

In 2004, the GAO completed another report on vehicle fleets, entitled *Federal Acquisition. Increased Attention to Vehicle Fleets Could Result in Savings*, released as GAO-04-664. The report was the product of a Congressional request from the Honorable Susan M. Collins and the Honorable Russell D Feingold. This report is the second of the two documents referenced in the NAVFAC TRIO process steps; its influence in the TRIOs foundation is principal.

Specifically, the GAO was asked to determine the following.

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[40] Naval Audit Service Report 030-98, "Management of Non-Tactical (Administrative) Transportation Vehicles," 16.

[41] Ibid.

A.   The extent to which agencies ensure that their fleets are the right size to meet agency missions

B.   Whether potential savings could result from the disposal of unneeded vehicles

C.   What actions are being taken on a government-wide basis to improve fleet management practices?[42]

To undertake this research, the GAO focused its review on the justification for acquiring and retaining vehicles at the Departments of Agriculture, Army, Homeland Security, Navy, and Veterans Affairs.[43]

The report noted that while the size of the vehicle fleet remained constant over the previous six years, concerns still existed that had been raised, extending for the previous decade, as to whether agencies were procuring more than required to meet their needs and missions. The results were interesting in that even in 2004, the issues noted in 1985, 1992, and 1995, and the recommendations made in the GAO report of 1995, had not been fully implemented as evidenced by the passage that reads:

> The agencies we reviewed cannot ensure that their vehicle fleets are the right size and composition to meet agency missions because of a lack of attention to key fleet management practices…policies at the agencies we reviewed do not generally call for clearly defined utilization criteria related to the mission of a vehicle—such as the number of trips per day or hours on station—to ensure that decisions to acquire and retain vehicles are based on a validated need…The Navy and the Forest Service do conduct assessments, but either they are done sporadically or the results are not enforced.[44]

In addition,

> …agencies generally have not established policies with clearly defined utilization criteria related to the mission of a vehicle to ensure that decisions to acquire and retain vehicles are based on a validated need. In

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[42] U.S. Government Accountability Office, *Federal Acquisition. Increased Attention to Vehicle Fleets Could Result in Savings* (GAO-04-664), 1, Washington, DC: GPO, 2004, http://www.gao.gov/new.items/d04664.pdf.

[43] Ibid.

[44] Ibid.

addition, agencies have not implemented periodic assessments to determine whether they have the right number and type of vehicles in the fleet…[45]

Ironically, this statement also appears to indicate that the recommendations made to the Navy and responded to by the CNO N4 in 1998 had not been fully implemented in 2004 either. Neither had the GSA nor the OMB taken swift action to implement some of the same recommendations.

As has been shown in the previous reviews dating back to 1985, the GAO, in its report, also noted that vehicle fleet efficiency on size and cost had been a topic of concern for many years. The report also notes that although the Office of Government Policy within the GSA develops policies, it is still the federal agencies themselves who are responsible for managing their own fleets to include making decisions about the type and number of vehicles needed. A flaw occurred in what GSA collected, as the data obtained was inaccurate because different agencies used different systems to collect and report information.[46]

More specifically, when addressing the need to establish utilization criteria, an absence of such measures indicated that local level officials were not making decisions based on substantiated need. Furthermore, many agencies, as it was pointed out, often ignored mileage standards for utilization, yet at the same time, failed to use other criteria to establish utilization when mileage was unsuitable, e.g., hours, passengers carried.[47] Also of note are the following excerpts:

> The Department of Defense prescribes that the military services establish utilization measures, such as passengers carried or hours used, to measure the need for a vehicle when mileage is not appropriate. However, [neither Army nor] Navy guidelines incorporate these types of utilization criteria.[48]

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[45] U.S. Government Accountability Office, *Federal Acquisition. Increased Attention to Vehicle Fleets Could Result in Savings*, 6.

[46] Ibid., 4.

[47] Ibid., 7.

[48] Ibid., 8.

Decisions about whether to acquire and retain vehicles are made at the local level with little or no headquarters oversight. These local-level decisions are frequently based on the availability of funds rather than on a validated need.[49]

Based on Inspector General Reports, it was estimated, based on selected activities (installations) reviews that the Navy, by end of fiscal year 2003, estimated fleet savings of $3.7 million per year if the recommended fleet reduction occurred; also referenced were the $19.8 million savings noted in the 1998 NAS Report. Unfortunately, savings resulting from reduction of vehicles are generally a result of pressures from budgetary shortfalls or pressure to reduce budgetary requirements vice methodical management employing utilization criteria to right size and eliminate excess.[50]

The recommendations from the 2004 GAO report are eerily familiar in many respects to the 1998 NAS Report: develop clear criteria based on utilization; benchmark periodically, employing the criteria established for utilization; and establish oversight to ensure compliance with both aforementioned items.[51] As previously mentioned, the information on the when the TRIO was established is not readily available, but it appears it was established sometime between 2009 and 2010. Additionally, a gap in information exists as it pertains to administrative, non-tactical vehicles from 2004 until 2011.

B.   VEHICLE FLEET MANAGEMENT PLAN[52]

The foundation for the vehicle fleet management plan was the Presidential Memorandum-Federal Fleet Performance released on May 24, 2011, and requires "all federal agencies conducting an annual Vehicle Allocation Methodology (VAM) to determine the optimum fleet inventory to meet mission requirements and identify

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[49] U.S. Government Accountability Office, *Federal Acquisition. Increased Attention to Vehicle Fleets Could Result in Savings*, 8.

[50] Ibid.

[51] Ibid., 13–14.

[52] Navy Fleet Management Plan, (n.d), https://portal.navfac.navy.mil/portal/page/portal/navfac/navfac_ww_pp/navfac_hq_pp/navfac_pw_pp/vam/fleet%20management%20report%202012_0.pdf.

necessary resources."[53] With the anticipated result of employing the memorandum would be "a Federal fleet that is comprised of smaller, more efficient, less greenhouse gas emitting vehicles that primarily operate on alternative fuels."[54]

The memorandum additionally states that:

The Navy's basis for the VAM is the Transportation Review of Inventory Objectives (TRIO) process. Currently the TRIO is conducted by the Echelon III,[55] Base Support Vehicles & Equipment (BSVE) Product Line Management Office (PLMO) on a triennial basis for all Navy activities. The TRIO validates inventory objectives (IOs) for all vehicles and equipment requirements for all Navy activities. In most cases a lead activity Facilities Engineering Center (FEC)/Public Works Department holds the IO for all tenants of an installation. In some circumstances DON organizational policy has individual activities not associated with an installation, which hold their own IOs. IOs are assigned based on the minimum number of units required to accomplish the activity's mission. As changes in mission, new functions, and/or functional transfers occur, the activity IO is revised on an interim basis.

Navy refers to their non-tactical vehicle fleet as Civil Engineering Support Equipment (CESE), or administrative vehicles, which is assigned only to those shore activities that have approved inventory objectives (IOs). In most cases CESE is supplied by the regional FEC through new procurement, rental, or lease, or by redistribution of excess equipment. In other instances CESE may be "owned" by a particular activity. Only the amount of CESE that is needed to accomplish the stated mission of an activity is assigned. Assessments are made annually by the PLMOs to determine if adjustments are needed due to mission changes or new tasking.

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[53] Navy Fleet Management Plan.

[54] Ibid.

[55] Reporting Echelon Structure: Echelon 1: NAVFAC HQ in DC, Echelon 2: NAVFAC Pacific in Pearl Harbor, Echelon 3: NAVFAC Pacific in Pearl Harbor, Echelon 4: NAVFAC Far East in Yoko, Echelon 5: NAVFAC Sasebo.

CESE is received at an activity to replace current inventory or to fill an unfilled IO and is not to be retained when in excess of an IO. When new or used CESE is received at an activity to replace current inventory, a reasonable period of time (generally 15 days) is allocated for the changeover to report excess and process paperwork before transferring equipment to disposal.[56]

Based on the Fleet Management Plan and the VAM requirement, "it is Navy's plan to validate the TRIO data annually," through usage criteria, to analyze exactly how the TRIO would do during a triennial review; in other words, a local TRIO done at each installation. The annual validation is a new requirement as of fiscal year 2012. To summarize, the TRIO establishes what each installation needs to do the job (IO), but, as will be demonstrated, each installation is then mandated to operate at a COL 4, which results in a service level significantly below 100% of what the IOs establish. Therefore, in essence, installations are being intentionally, systematically, and significantly under-resourced.

C.   OBJECTIVE OF THE TRIO[57]

The objective of the TRIO is to validate IOs through triennial baselines. Through this baseline, an IO could be added if a valid new requirement exists or deleted if the requirement is not deemed valid. To validate the IOs, and as stated in the Fleet Management Plan (2012), the TRIO considers the following objective criteria when conducting the baseline:

1.   Mission

2.   Historical/expected miles of use per vehicle

3.   Historical/expected hours of use per vehicle

4.   Ratio of employees to vehicles

5.   Frequency of trips per vehicle

6.   Vehicle function

7.   Operating terrain

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[56] Navy Fleet Management Plan.

[57] Ibid.

8. Climate

9. Vehicle condition, age, and retention cycle

10. Vehicle down time

11. Needed cargo and/or passenger capacity

12. Required employee response times

13. Greenhouse gas emission level of the vehicle

The Navy also collects additional information about each vehicle through user surveys. Such subjective information can provide valuable insight into the objective criteria. For example, a fire truck may have low utilization as it is on standby, but it is necessary that it be available and prepared to respond to emergencies.[58]

These survey questions are a major factor when conducting the TRIO and serve as a means of obtaining the listed objective criteria. The survey questions can be found in Appendix B.

D.   STEPS AND PROCESS OF THE TRIO[59]

The TRIO is a three-step process with sub-processes within each step. Each step is briefly described below; a more in-depth description is provided in Appendix F.

Step 1 initiates the TRIO and is done when the command receives a TRIO announcement letter and an interview worksheet (Appendix C).

Step 2 is the actual TRIO being conducted. The procedures are broken out according to the person responsible; the underlying documents for this step are the GAO Report, GAO-04-664, and the Naval Audit Service Report, 030-98; both were previously discussed in Chapter II.

Step 3 is the TRIO follow-up. For this step, the IO decision-making process, the flow chart on how to determine a valid IO, an updated COL matrix, and an IMAP break down of what tenant command belongs to which IMAP level, are the guiding documents.

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[58] Navy Fleet Management Plan.

[59] Information obtained from e-mail message to the author, Sasebo, December 4, 2012; NAVFAC, "B-8.1.7 Transportation Review of Inventory Objectives (TRIO)," updated January 4, 2007.

The IO decision-making process and flow chart are found in Appendix C, the updated COL matrix is Appendix A (previously mentioned in Chapter II).

The most relevant parts of the TRIO for this project are discussed in more detail in Chapter IV, Section C.

Once the TRIO has concluded, a letter is sent to the region with the results either increasing or decreasing the IOs; if an IO decreases, then those vehicles are removed from use. At that point, the TRIO has completed the triennial assessment. It is still incumbent upon the installation to do its annual assessments, which are in essence the same analysis that the TRIO does, only it is done in house and forwarded to the cognizant Echelon III for further upload into higher tier reporting systems.

E.   TRIO RESULTS FOR NAVFAC FAR EAST[60]

During the time frame of April 20 through June 25, 2010, the Far East (Japan, Diego Garcia, Singapore, and Korea) underwent their triennial TRIO, which was conducted by the NAVFAC PAC TRIO team and was performed on-site with interviews at each PWD with current support equipment users to determine minimum vehicle and equipment quantities, as well as types of CESE necessary to meet their mission requirements. (These identified quantities then become the IOs and are the high limit(s) on vehicle allowance(s).) The analysis of requirements was based on fuel economy, utilization history, and other factors, such as hours, location, etc. Furthermore, the synopsis states that the goal of the 2010 TRIO was to

> determine the most efficient and cost effective means of providing transportation, such as sub-pooling and short-term rental versus full-time assignment. Discussions addressed vehicle/equipment requirements/ justifications, mission requirements, and current/projected manpower availability. As a result of these discussions, vehicle/equipment quantities and configurations were established to meet NAVFAC Far East's current and future CESE requirements.[61]

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[60] NAVFAC Far East Trio Synopsis, e-mail message to the author, November 1, 2011.

[61] Ibid.

It should be noted that during the TRIO, "no CESE non-compliance or policy issues were identified during the TRIO review and interview process that required attention or corrective action to bring the BSV&E program into compliance occurred"[62].

The results addressed the regional IOs of the Far East. The TRIO's overall objective was:

> …to identify and validate vehicle and equipment requirements in detail for NAVFAC Far East and its supported commands through the Far East AOR. Special emphasis was placed on identifying opportunities to change from passenger carrying vans to compact four-door pickup trucks or panel vans at sites where GSA leased assets are not available to minimize Passenger Carrying Vehicles (PCV) requirements in order to continue meeting mission requirements while offsetting shortfalls in available OPN funding for PCVs. In an effort to meet SECNAV's policy on petroleum reduction for non-tactical fleets, the team also looked at opportunities to downsize to more fuel efficient and lower gross vehicle weight rating (GVWR) vehicles, where applicable.[63]

After the review of IOs was finished, 283 additional IOs were noted, which raised NAVFAC Far East's total validated and authorized IOs to 2,567 up from 2,284. Although the document does not make the root cause of the increase clear, it is highly likely that the increase resulted from increased mission requirements from numerous different customers that NAVFAC Far East services.

NAVFAC Far East Inventory Objectives by customer type is as follows.

Customers	Percentage
CNIC	22%
B-Pool (Internal FEC)	16%
C-Pool (Internal FEC)	35%
Reimbursable (External FEC)	27%
Total	100%[64]

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[62] NAVFAC Far East Trio Synopsis.

[63] Ibid.

[64] Ibid.

Of special note was the focus on NMC and Mobile Mine Assembly Units (MOMAU) in which the TRIO results stated:

> During previous TRIOs Naval Munitions Command (NMC) and MOMAU were considered separate customers. OPNAVNOTE 5400, Ser DNS-33/9U107639 dated 20 September 2009 combined MOMAUs with NMC EADs throughout the Pacific. As a result 71 IOs transferred from the CNIC funded pools to the External FEC (reimbursable) pools at Atsugi, Diego Garcia, Misawa, Okinawa, Sasebo, and Yokosuka.[65]

The TRIO Team from NAVFAC PAC synopsis also highlights, "While some customers no longer had full-time requirements for vehicles/equipment, those reductions were offset by the overall increase in requirements of existing customers."[66] Additionally, a bullet point also addressed right hand drive vehicles (RHD), and requested an increase on the price threshold to raise the threshold to $45,000 up from $30,000; this request was anticipated to be addresses in the fiscal year 12 legislative session in Congress. The reason this is important is that most government vehicles in the Far East, and specifically all vehicles in Japan, are RHD. All vehicles in Sasebo are also purchased vice being leased. The leasing of vehicles is available stateside through GSA; however, this option not available in the Far East or Sasebo.

F.   SUMMARY

The TRIO has combined the best of these recommendations that date back to 1985, and is now the standard for Navy Vehicle Management. It is the TRIO, which is conducted every three years, that forms the baseline, and hence, the foundation on which this research arose. This study uses the TRIO established IO for Sasebo as the high limit on vehicle allowance(s) to optimize the number and mix of vehicles. The TRIO establishes what the personnel need to do their job (IO) but as seen, the installation is then mandated to operate at a COL 4, implying a service level significantly below 100% of what the IOs establish. In essence, installations are being intentionally, systematically, and significantly under-resourced. As with all instances of when entities are under-

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[65] NAVFAC Far East Trio Synopsis.

[66] Ibid.

resourced/under-funded, it becomes incumbent to accept certain levels of risk and mitigate those risks as best as possible. Ultimately, the need for centralized/regional fleet managers to provide oversight to the local-level managers who maintain budgetary control is essential. Similarly, the need for the creation of a central repository of data in the form of a fleet management information system is also critical. More than those criteria however, the importance of the need to establish appropriate utilization criteria that will ensure efficiency in vehicles fleets and the need for periodic assessments of the vehicle fleets is more critical than ever. These two drivers (financial limitations and the TRIO) are part of the reason why optimizing vehicles is crucial.

IV. SASEBO

Commander Fleet Activities Sasebo is "located on Kyushu Island, about 45 miles from the prefecture's capital of Nagasaki, 78 miles from Fukuoka, the largest city on the island, and about 600 miles by air from Tokyo."[67]

> The installation is composed of 12 separate areas, including housing areas, on 1,285 acres bordering on, or near, Sasebo Harbor and has a base population of roughly 6,000. CFAS includes a main base area, three off-base housing areas, three fuel facilities, two ordnance facilities and a Landing Craft Air Cushion laydown site.[68]

CFAS is the home of the Navy's only forward-deployed Amphibious Ready Group, anchored by USS BONHOMME RICHARD (LHD 6). Supporting BONHOMME RICHARD, along with seven other forward-deployed ships and all U.S. Seventh Fleet ships, is the mission of this installation. "The base is strategically important in carrying out our defense treaty with Japan to ensure peace and stability throughout the region."[69] It is also worth mentioning that, "Sasebo has been an important naval base since 1889, when the Sasebo Naval Station began operations on July 1st as headquarters for the Imperial Japanese Navy's Third Naval District."[70]

A.   BRIEF HISTORY OF SASEBO

> On September 22, 1945, the 5th Marine Division landed at Sasebo, and in June 1946, U.S. Fleet Activities Sasebo was formally established. When war broke out in Korea four years later, Sasebo became the main launching point for the United Nations and U.S. Forces. Millions of tons of ammunition, fuel, tanks, trucks and supplies flowed through Sasebo on their way to U.N. Forces in Korea. The number of American military personnel in Sasebo grew to about 20,000. After the Korean War ended, Japan established its Self Defense Forces, and Japan Maritime Self

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[67] CNIC//Commander Fleet Activities Sasebo, "Visitor Information," (n.d.), http://cnic.navy.mil/Sasebo/InstallationGuide/VisitorInformation/index.htm.

[68] CNIC//Commander Fleet Activities Sasebo, "Welcome to Commander Fleet Activities Sasebo," (n.d.), http://cnic.navy.mil/Sasebo/index.htm.

[69] Ibid.

[70] CNIC//Commander Fleet Activities Sasebo, "Visitor Information."

Defense Force ships began to homeport in Sasebo as U.S. Fleet Activities Sasebo continued to support ships of the U.S. Seventh Fleet. Service Force ships as well as mine warfare mission craft also made Sasebo their homeport.

U.S. Fleet Activities Sasebo provided heavy support to the expanded Seventh Fleet during the years of war in Southeast Asia (i.e. the Vietnam War era). Repair work completed by Japanese shipyards in Sasebo was then, and is still today, equal to the best in the world. Operations at U.S. Fleet Activities Sasebo were scaled back during the mid-1970s and the base was designated as a Naval Ordnance Facility, while fleet visits dwindled to a very low level.

On July 4, 1980. U.S. Fleet Activities Sasebo regained its name and once again, Seventh Fleet ships were forward deployed to Sasebo. Since then, U.S. Fleet Activities Sasebo has been home to USS ESSEX (LHD 2), USS BONHOMME RICHARD (LHD 6), USS TORTUGA (LSD 46), USS GERMANTOWN (LSD 42), USS DENVER (LPD 9), USS GUARDIAN (MCM 5), USS PATRIOT (MCM 7), USS AVENGER (MCM 1), USS DEFENDER (MCM 2) and some 5,600 military members and their families as part of the Forward Deployed Naval Forces.

U.S. Fleet Activities Sasebo played a vital logistics role in 1990-91 during Operation Desert Shield/Storm by serving as a supply point for ordnance and fuel for ships and Marines operating in the Persian Gulf Theater.[71]

U.S. Fleet Activities Sasebo currently supports 10 tenant commands to include the Ship Repair Facility—Japan Regional Maintenance Center (SRF-JRMC) Detachment Sasebo,[72] seven departments,[73] eight permanently assigned forward deployed ships ranging in size from LHD to MCM, one Afloat Flag Officer staff (COMPHIBRON ELEVEN), two mine countermeasure divisions (COMCMDIV ELEVEN and COMCMDIV THREE ONE), Fleet Logistics Center (FLC) Yokosuka Detachment Sasebo, and various other visiting U.S. Navy ships that pull into port in Sasebo.[74]

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[71] CNIC//Commander Fleet Activities Sasebo, "Visitor Information."

[72] CNIC//Commander Fleet Activities Sasebo, "Tenant Command," (n.d.), http://cnic.navy.mil/Sasebo/About/TenantCommands/index.htm.

[73] CNIC//Commander Fleet Activities Sasebo, "Commander Fleet Activities Sasebo by Department," (n.d.), http://cnic.navy.mil/Sasebo/About/Departments/index.htm.

[74] CNIC//Commander Fleet Activities Sasebo, "FDNF Ships," (n.d.), http://cnic.navy.mil/Sasebo/About/FDNFShips/index.htm.

For over 120 years, two great navies, first the former Imperial Navy and now the U.S. Navy, have called Sasebo home and the "U.S. Fleet Activities has supported Seventh Fleet units as they continue to ensure peace and security in the Pacific region" by "providing superior support" to forward deployed U.S. forces through "excellence in Shore Installation management through proactive leadership and seamless command integration."[75] One way support is provided is through administrative vehicles.

B.   WHY CHOOSE SASEBO?

> Yokosuka comprises 568 acres, not including three separate base housing areas, and is located 43 miles south of Tokyo at the entrance of Tokyo Bay and approximately 18 miles south of Yokohama. Yokosuka is on the Miura peninsula in the Kanto Plain region of the Pacific Coast in Central Honshu, Japan. Commander Fleet Activities Yokosuka (CFAY) is the largest overseas U.S. Naval installation in the world and is considered to be one of the most strategically important bases in the U.S. military. Additionally, CFAY encompasses over 50 forward-deployed tenant commands in Yokosuka support WESTPAC operating forces, including principle afloat elements of the United States Seventh Fleet and Commander Destroyer Squadron 15, including the only permanently forward-deployed aircraft carrier, USS GEORGE WASHINGTON (CVN-73). There are approximately 24,000 military and civilian personnel who live and work on board Yokosuka naval base.[76]

Given Yokosuka's size, number of tenant commands and personnel, it was too large and complicated a structure to use as a case study without the influence of extraneous circumstances that might significantly impact how the results of the model could be applied.

"Naval Air Facility (NAF) Atsugi lies is approximately 16 km west of Yokohama and about 36 km southwest of Tokyo"[77] on "1,249 acres in the heart of the Kanto Plain on Honshu, the main island of Japan, in Kanagawa Prefecture, in Ayase City, NAF

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[75] CNIC//Commander Fleet Activities Sasebo, "Mission and Vision," (n.d.), http://cnic.navy.mil/Sasebo/About/MissionAndVision/index.htm.

[76] CNIC//Commander Fleet Activities Yokosuka, "Mission and Vision," (n.d.), https://www.cnic.navy.mil/Yokosuka/About/MissionAndVision/index.htm.

[77] CNIC//Commander Fleet Activities Atsugi, "About," (n.d.), https://www.cnic.navy.mil/Atsugi/About/index.htm.

supports more than 40 tenant commands; it is the only Naval installation supporting an entire forward deployed Carrier capable Air Wing There are approximately 10,000 personnel, including U.S. military, JMSDF, civilians, family members and Japanese National employees in the current Atsugi community." [78] NAF Atsugi, as was the case with Yokosuka, has too many variables and is too large based on the number of tenant commands and personnel supported.

"NAF Misawa is a tenant command located on Misawa Air Base, located approximately 400 miles north of Tokyo, adjacent to Misawa City in the Aomori Prefecture,"[79] "near the northern tip on Honshu Island."[80] "There are more than 160 personnel assigned to the NAF and more than 700 personnel in tenant commands receiving direct support from the NAF."[81]

Sasebo was chosen as the location to study based not only on the fact that it is historically an important asset to 7th Fleet, but also because the size of the installation and its geographical separation from mainland Japan makes for a stable infrastructure and a good case study. While the physical area of the base covers more acreage than Yokosuka or Atsugi, the Sasebo critical factors, such as the number of tenant commands, personnel supported, and isolated location on a separate island, made it more suitable for a case study and also gave a more manageable set of data to analyze. It is a microcosm of all factors in play.

C.   FLOW OF DOCUMENTS TO GET TO WHAT IS BEING USED IN HOUSE

Sasebo currently uses a complex approach to obtain its aggregate COL level; the complexity is not in the layout but rather with how the flow of information needs to be

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[78] CNIC//Commander Fleet Activities Atsugi, "History," (n.d.), https://www.cnic.navy.mil/Atsugi/About/History/index.htm.

[79] CNIC//Commander Fleet Activities Misawa, "About," (n.d.), https://www.cnic.navy.mil/Misawa/About/index.htm.

[80] CNIC//Commander Fleet Activities Misawa, "Welcome to Naval Air Facility Misawa," (n.d.), https://www.cnic.navy.mil/Misawa/About/Command/index.htm.

[81] CNIC//Commander Fleet Activities Misawa, "Welcome to Naval Air Facility Misawa," (n.d.), https://www.cnic.navy.mil/Misawa/index.htm.

read to assimilate the information correctly and make the right conclusion. To understand better the flow of how the documents work together to establish the end state COL, review Figure 2 more in depth. Information used to populate Figure 2 is taken from the TRIO established baseline (represented as the IO on the matrix), current on-hand inventory, and CNIC promulgated information (Figures 4 and 5) to derive a final product. Figure 2 shows the flow of interaction between the all the factors and subcomponents, including the documents previously discussed and presented in Appendix C.

TRIO Interview Worksheet

In-house Sasebo

Priority	IO	On-Hand	Fill rate %	Score		COL
1	11	11	100.00	8.75		
2						
3	4	4	100.00	9.5	8.08	2
4						
5	22	16	72.73	6		
6					Avg Score	
	37	31				

COL

Range	COL
10.00-9.00	1
8.99-7.00	2
6.99-5.00	3
4.99- Below	4

Sasebo Current Vehicle Listing

		Mini COL		
	COL 4	COL 3	COL 2	COL 1
PRI 1		0-89	90-99	100
PRI 2	0-79	80-94	95-99	100
PRI 3	0-66	67-84	85-96	97-100
PRI 4	0-63	64-81	82-90	91-100
PRI 5	0-55	56-79	80-88	89-100
PRI 6	0-45	46-74	75-85	86-100
Whgt score Pri 2-6	3	6	8	9.5
Whgt score Pri 1		3	6	8.75

Figure 2.   Flow of Documents

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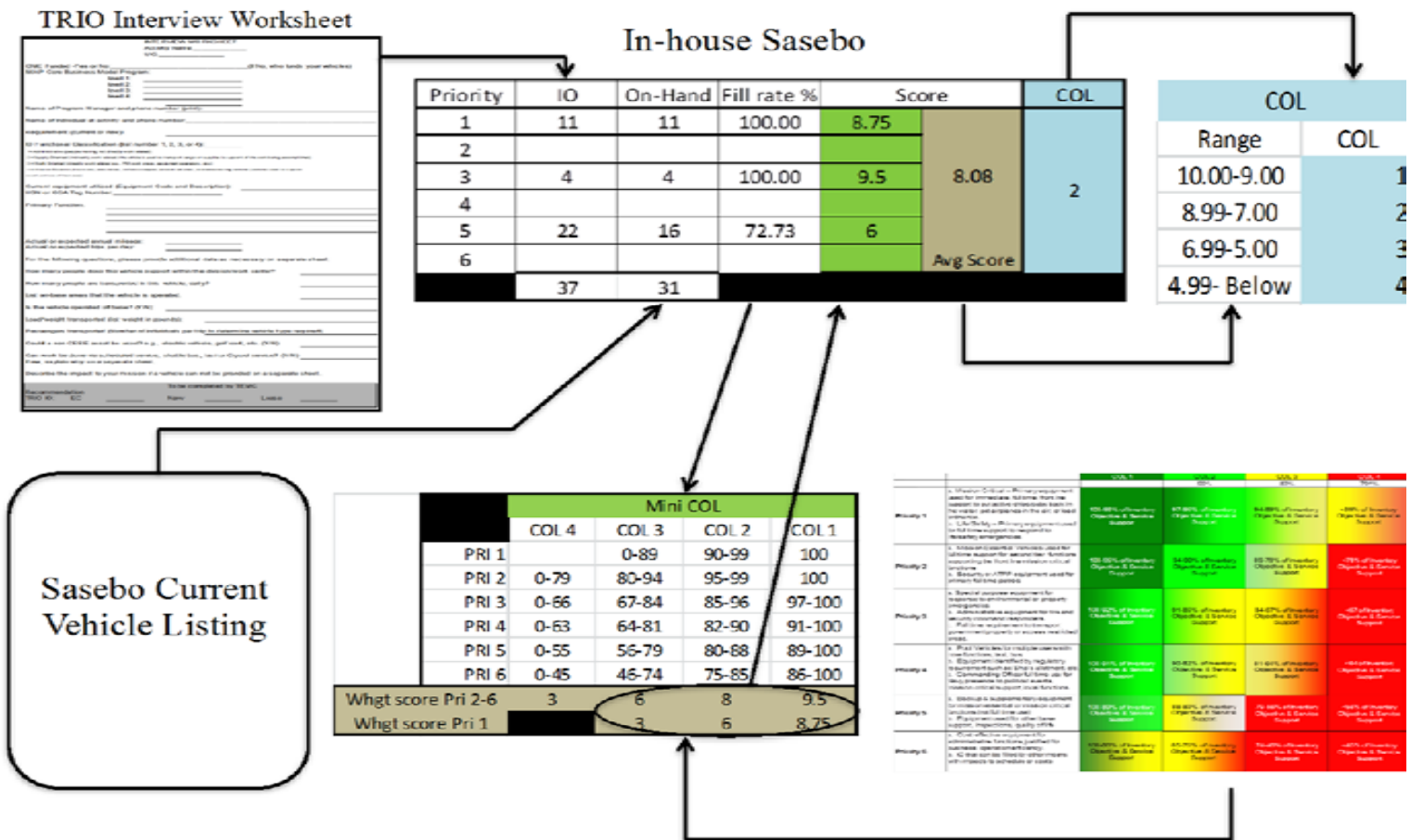
Figure 2 is best discussed step by step. The steps essential in navigating Figure 2 are given in the following paragraphs.

In Step 1, the TRIO conducts an interview via the worksheet (shown in Appendix B); one interview worksheet per vehicle is done. Once all the interviews are completed, the TRIO team takes the worksheets and reviews them to establish whether the vehicle is valid or not. Once validated, the vehicle then becomes an IO. The IOs are then summed for each priority to establish the aggregate IOs that then translates to the "IO" column in the "In-house Sasebo" matrix. (Note that Sasebo only has established IOs for Priority 1, 3 and 5 vehicles; rows for the other priorities are therefore left blank.)

Step 2 populates the "On-hand" column in the same In-house matrix using the information from the "Sasebo Current Vehicle Listing." This "On-hand" column is what is actually on the road.

Step 3 determines fill rate from and uses information from step 1, the "IO" established by the TRIO, and step 2, the "On-hand" quantity. The fill rate is simply the "On-hand" divided by the "IO."

Step 4 takes the fill rate percentage for each priority determined in step 3, which is then looked up by priority where that percentage falls on the "mini-COL" matrix. Once the column in which it falls is determined, follow the column down to the bottom on the "mini-COL" matrix and assign the appropriate weighting factor for that priority. That weighting factor is then plugged into the green column of the "In-house Sasebo" matrix for each priority. It should be noted that the rainbow matrix is what feeds the COL ranges in the "mini-COL" matrix.

Step 5 averages the weights assigned to each priority. Once the weighting factors for each priority are assigned, they are then averaged. This weighted average is the numerical value seen in the next-to-last column of the "In-house Sasebo."

Step 6, the final step, determines our COL level. The weighted average obtained from step 5 is translated to obtain the overall COL by taking the weighted average in the next-to-last column of the "In-house Sasebo" matrix and comparing it to the final COL

table with the ranges and COL columns. Find where the weighted average falls on the range and then follow that over to find the COL.

Now that the basic steps of how the "In-house Sasebo" matrix works have been discussed, an example is now presented. Figures 3, 4, and 5 are used, which are magnifications of the tables as shown in Figure 2. In Figure 3, priority one has an on-hand of 11 and the IO is 11. The fill rate for priority 1 is 100% (11/11= 100%). That 100% is taken for priority one. Continue to Figure 4, "Mini COL," and see that for priority 1, a fill rate of 100 renders a "Mini COL" of 1. Next, follow the "Mini COL" COL 1 column down to the "Whgt score Pri 1" row and see that for priority 1, COL 1, the weighting factor, is 8.75. That 8.75 is then plugged into the green shaded column in the priority 1 spot in the "Score" column. This process is repeated for all remaining priorities, and the weighting scores of 9.5 and 6 for priorities 3 and 5, respectively, are obtained. Therefore, now that weighting scores of 8.75, 9.5, and 6 are known, they are averaged together and the average weighted score of 8.08 is attained. With the average score of 8.08, the "COL" matrix in Figure 5 is referenced, and it is seen that 8.08 falls into the 8.99–7.00 range that corresponds to a COL 2. This COL 2 is the overall (aggregate) COL for this example.

Priority	IO	On-Hand	Fill rate %	Score		COL
1	11	11	100.00	8.75		
2						
3	4	4	100.00	9.5	8.08	2
4						
5	22	16	72.73	6		
6					Avg Score	
	37	31				

Figure 3.   In-house Sasebo Self-Assessment Done in Fall 2011

		Mini COL			
		COL 4	COL 3	COL 2	COL 1
	PRI 1		0-89	90-99	100
	PRI 2	0-79	80-94	95-99	100
	PRI 3	0-66	67-84	85-96	97-100
	PRI 4	0-63	64-81	82-90	91-100
	PRI 5	0-55	56-79	80-88	89-100
	PRI 6	0-45	46-74	75-85	86-100
Whgt score Pri 2-6		3	6	8	9.5
Whgt score Pri 1			3	6	8.75

Figure 4.   Mini-COL

COL	
Range	COL
10.00-9.00	1
8.99-7.00	2
6.99-5.00	3
4.99- Below	4

Figure 5.   Aggregate COL

D.   ANALYSIS

The reference model, Figure 2, can be used to determine the overall COL value for a given mix of vehicles. This model also provides an avenue for testing how the mix would need to change to achieve a given COL value. Based on the information gathered in the data analysis and through document (evidence) reviews, the specific practices and examples could then be used to elaborate on possible improvements and provide the groundwork for the implementation of improvement recommendations to allow all stakeholders (from Base CO to PWO and customer) to analyze the impact of any improvement recommendations, prioritize these recommendations and adapt the change(s) to the applicable situation.[82]

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[82] The TMM*i* Foundation, "Test Maturity Model integrated (TMMi) for Process Improvement," (n.d.), http://www.tmmifoundation.org/downloads/resources/Whitepaper.Accenture.2010.pdf.

Process improvement projects based on improvement recommendations should not be taken lightly, but set up and planned as a separate project. Establishing that each improvement recommendation is (productive) criticism of the current status quo is critical to understanding and acceptance. Therefore, characterization of current tools for analysis should be done based on processes, not people, to achieve broad buy-in to the recommended changes. Using the assessment results as an indicator of the effectiveness of current tools in-use helps with defining gaps against the goals and also sheds light on the goals (vision, mission) for the organization itself. Existing gaps and strengths can be identified and utilized to define concrete objectives, i.e., maximizing the number of vehicles, reducing the COL level if it is above the mandated COL 4 (mandated appropriate readiness), decreasing the cost if excess vehicles are removed, and meeting mission requirements.[83]

The flow of documents and the derivation of how to determine if the mandated end state, a COL 4, was achieved, lead to the conclusion that an optimization model that also rolled up the current matrix in use could improve the decision-making process of what vehicles to keep in the hands of the customers while still attaining a COL 4. Although the matrix and resulting product may be considered satisfactory, it seems clear that the presence of a new analysis tool has the potential to improve the process.[84]

The matrix currently "as-is" does not employ an optimization model to determine what the best on-hand quantity should be given the restrictions that CNIC requires all commands to operate from (Figures 3 and 4). The need to operate within the restrictions in a more efficient manner, in this case maximizing the number of vehicle missions available while minimizing costs, motivates this research. Thus, the need exists to develop and provide a tool that considers all factors and provides a more robust picture from which to base decisions on when looking to right size and continually live within the means mandated.

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[83] The TMM*i* Foundation, "Test Maturity Model integrated (TMMi) for Process Improvement."

[84] Verbiage is pulled directly from an NPS thesis. Roberto Quintas Ratto, *An Analysis of Adopting RFID in the Brazilian Air Force Uniform Sales* (master's thesis, Naval Postgraduate School, 2011), 30.

V. MODEL CHALLENGES, ASSUMPTION, INPUTS, FORMULATION, AND IMPLEMENTATION

This chapter introduces a mathematical model used to optimize NMCs "B" Pool vehicles. The objective of this model is to maximize the number of the vehicles in the "B" Pool at NAVFAC Sasebo, Japan, subject to a number of constraints—maintaining cost below a budget, honoring mandated COL requirements, to name a couple. The objective, ultimately, was to not only to determine the optimal number of vehicles, but also to produce a working excel optimization model for NAVFAC Sasebo that can be used as a decision-making tool for use in the future. To do so, the author took one tenant command within CFAS, NMC, and constructed a representative model that was pragmatic, operational, and based on input that originated from within NAVFAC Sasebo in an assessment conducted in Fall 2011. During the previous TRIOs, NMC was considered a separate customer, as discussed in Chapter III. After the 2011 TRIO, they are required to attain the current COL 4 mandate. The author can reasonably represent numerous complex components through the use of mathematical modeling, which can be quantified and applied to address vehicle allocation.

A. DECISION VARIABLES

The first step in any formulation of an optimization problem and model is to start with defining the decision variables. As stated by both Jiminez et al. and Balakrishnan et al., decision variables are, by definition, "variables that represent the unknown entities in a problem and expressed using alphanumeric symbols."[85,86] The author needed to solve for the number of vehicles that would satisfy the requirements in Sasebo while still attaining a COL 4. Therefore, the primary decision variables used were the number of each specific vehicle type within each priority level. For this step, three indexes were

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[85] Jiminez, Wamsley, and Priscoe, "Optimizing the Ground Mobile Radio Basis of Issue for the U.S. Army Heavy Brigade Combat Team," 63.

[86] Nagraj Balakrishnan, Barry Render, and Ralph Stair, *Managerial Decision Modeling with Spreadsheets* (2nd. ed.) (Upper Saddle River, NJ: Prentice Hall, 2007), 28.

assigned: *v*, *p*, and *l*. The letter *v* was used to index the specific vehicle types in inventory at Sasebo; *v* had values that ranged from 1 to 13. Table 1 shows the assignment of *v=1* to *13* and the corresponding vehicle type.

$v=$ Vehicle Type	
v	Vehicle Type
1	0319-0J
2	0319-MJ
3	0329-MJ
4	0330-0J
5	0343-0J
6	0603-0J
7	0605-0J
8	0614-0J
9	0636-0J
10	0816-00
11	0832-00
12	0862-00
13	8254-00

Table 1.   Indexes *v*=1 to 13

The second index employed was *p*, which represented the different priority levels and ranged from 1 to 6. If there are more than one of a specific vehicle, that vehicle type could have more than one priority, if there was only one of that specific vehicle, it has only one priority. Table 2 shows the assignment of *p* =1 to 6.

$p =$ Priority Level	
p	Priority Level
1	1
2	2
3	3
4	4
5	5
6	6

Table 2.   Indexes *p* =1 to 6

A third index, *l*, was assigned to designate the COL in which the priority fell. COLs range from 1 to 4. Table 3 defines *l*=1 to 4.

l= COL Level	
l	COL Level
1	COL 1
2	COL 2
3	COL 3
4	COL 4

Table 3.   Indexes *l*=1 to 4

This model has three different sets of decision variables. Both indexes *v* and *p* are combined in the definition of the decision variables for vehicles; each decision variable in this set represents the quantity of each vehicle type in each priority, and must be integer. The second set of decision variables is y_p. These decision variables represent the average fill rate percentage for all vehicles within the priority level *p* and will be calculated based on the values of the $x_{v,p}$ decision variables. The third set of decision variables is a set of helper variables that determine whether or not the fill rate for a given priority *p* falls within a given COL level *l*. These variables, $S_{p,l}$, are defined as binary and constrained to equal 1 if the fill rate for priority *p* falls within the specified range of COL level *l*, or 0 if it does not. Each of these decision variables is formally defined below:

$x_{v,p}$:= the number of vehicles (v) 1-13 assigned to each (*p*) 1-6

y_p := the percentage of fill rate by priority

$S_{p,l}$:= an indicator variable that equals 1 if y_p falls within the Mini COL range for

COL level *l*, and equals zero otherwise

It is critical to track not only the number of vehicles within a given priority but also how many vehicles of each type are assigned to a specific priority. Without this

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added detail, if a vehicle type were authorized to be in more than one priority, neither the author nor the end user of the model would have been able to determine how many vehicles of this type should have been allocated to each priority. The model, as developed, captures this essential element.

B.   OBJECTIVE FUNCTION

"The goal of an organization as an intent to maximize or minimize some important quality" is how Balakrishnan et al. define an objective function.[87] This model's goal is to maximize the number of vehicles in all priorities available to fulfill mission requirements.

Equation 1 is the objective function equation. It calculates the total number of vehicles by priority group, Accordingly, the objective function equation, reading right to left, sums over all p within a v.

$$\text{Maximize} \sum_{v=1}^{13} \sum_{p=1}^{6} x_{v,p} \qquad (1)$$

C.   MODEL INPUTS

With the assumptions and challenges above, the model inputs were then able to be determined. The model inputs considered were cost of each type of vehicle, COL level %, budget, maximum number of vehicles authorized.

1.   Vehicle Costs

NMC operates 13 different vehicles ranging from cranes to semi-trailers to passenger vehicles. All vehicles with the exception of trailers and cranes are right-hand drive vehicles. To identify and state the goal of achieving this maximization correctly, the cost of each vehicle type must be defined. Table 4 shows the cost of each vehicle, C_v, for $v=1$ to 13.

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[87] Balakrishnan, Render, and Stair, *Managerial Decision Modeling with Spreadsheets*, 64.

C_v= Cost of Each Vehicle Type			
C_v	Vehicle Type	Vehicle Nomenclature	Cost
1	0319-0J	Cargo Truck 4x2 Compact	$ 5,568.00
2	0319-MJ	Cargo Truck 4x2 Mini	$ 4,416.00
3	0329-MJ	Panel Truck Van	$ 4,416.00
4	0330-0J	Passenger Van	$ 7,680.00
5	0343-0J	1T Stake Truck	$ 5,760.00
6	0603-0J	5T Stake Truck 4x2	$ 8,640.00
7	0605-0J	5T Van	$ 9,600.00
8	0614-0J	7.5T Tracto Truck 4x2	$ 10,560.00
9	0636-0J	10T Stake Truck 6x4	$ 11,520.00
10	0816-00	20T Semi Trailer Stake	$ 3,840.00
11	0832-00	Trailer Forklift	$ 3,840.00
12	0862-00	Tiltdeck Forklift	$ 7,680.00
13	8254-00	12-35T Crane 4x4 Hydraulic	$ 57,600.00

Table 4.   Vehicle Cost by Vehicle Type

2.   COL Level % (Range for COL 1–4 by Priority)

NAVFAC vehicle pools are currently forced to operate at a COL 4 and 67% funding level, as discussed in Chapter II, which will remain true into the foreseeable future. The final COL is determined by averaging the individual priority COL weights delineated in Figure 4 and comparing it to Figure 5 to obtain overall COL.

3.   Budget

The budget is an important input when developing the model as it is the upper threshold of funds that the tenant command has allocated to fulfill their vehicle requirements. Determination of the budget used in the model will be explained further in Section D.

4.   Maximum Number of Authorized Vehicles (Aggregate and by Priority—As Established through Validated IO by TRIO)

The number of authorized vehicles is 37; however, only 31 vehicles were assigned as of December 2011. The six not filled were new requirements whose IO was

established during the TRIO. To capture the full allowance authorized, the model was developed with the maximum number being the TRIO established IO values. Figure 6 provides the specifics for the vehicles (IOs) that the TRIO authorized in their 2010 review.

	0319-0J	0319-MJ	0329-MJ	0330-0J	0343-0J	0603-0J	0605-0J	0614-0J	0636-0J	0816-00	0832-00	0862-00	8254-00	
Priority 1	0	0	0	0	2	0	0	1	1	2	1	1	3	11
Priority 3	0	2	1	0	0	0	0	1	0	0	0	0	0	4
Priority 5	4	0	7	5	0	2	1	2	1	0	0	0	0	22
TOTALS	4	2	8	5	2	2	1	4	2	2	1	1	3	37

Figure 6.   TRIO Established Authorizations for NMC.

D.   CHALLENGES AND CONSTRAINTS

During the course of gathering and analyzing data, the author encountered several challenges that required the making of assumptions, which will be expanded upon later in this section. First, the budgeting and escalating financial constraints throughout the DoD were considered. The next constraint taken into consideration was the weighting factors. Although the author was unable to determine the underlying logic behind the weights, they were nonetheless incorporated into the model. A third consideration was the COL percentages. Since a discrepancy occurred between two CNIC promulgated COL percentages tables, only considered was the table applied to the analysis on NMC conducted in Fall 2011. Fourth, a minimum budget constraint was added to avoid an optimal solution of zero vehicles. Although minimum budgets are rarely established in the DoD, not-to-exceed, or maximum budget are commonplace. A similar assumption was needed for a minimum number of vehicles that would be acceptable that was determined based on the best information available. Other challenges encountered include the formulation of an optimization model suitable for a broad application region wide, suitability of the model when modified and utilized in analyzing other tenant commands, network and constraints.

Before proceeding further, it is first necessary to define a constraint in the context of optimization modeling. Balakrishnan et al. state, "constraints denote conditions which

prevent us from selecting any value we please for the decision variables."[88] The following specifically addresses the challenges and assumptions, identified immediately above, in more detail.

1.   Maximum and Minimum Budget

In light of the self-imposed $500B in budget reduction and the ever-looming sequestration of an additional $500B starting in January 2013, funding for DoD discretionary funding could be appreciably constrained. Vehicles are in the O&M category of discretionary funds[89,90] and given the previous discussion, vehicles are major cost drivers in the DoD; they will likely come under heightened scrutiny in the future. Coupling that with the global financial crisis, an ever-increasing national debt, and an economy weary after funding 10 years of war, it can be seen how fiduciary responsibility is of utmost importance. With this challenge in mind, finding optimal solutions within 67% funding is of paramount significance and was a critical factor; it establishes the maximum budget or upper threshold of funds granted to NMC via NAVFAC Sasebo for the entire fiscal year. If authorized funds are exceeded, numerous implications can arise. In a best case scenario, funds will be re-allocated from one tenant to another, and in a worst case scenario, funds would be obligated beyond the amount authorized that could trigger an Anti-Deficiency Act violation.

The maximum budget established for NMC was $271,104, which includes all operating funds and all maintenance funds allocated for all vehicles. Equation 2 shows the constraint for the maximum budget.

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[88] Balakrishnan, Render, and Stair, *Managerial Decision Modeling with Spreadsheets*, 29.

[89] "DoD's O&M funds are considered by many to be more discretionary than other types of defense appropriations." Appendix 3 of Decision B-213137 by the Comptroller General of the United States to the Honorable Bill Alexander, U.S. House of Representatives dated June 22, 1984.

[90] Figure 7: FY 2012 FYDP by Title (base discretionary budget in FY 2012 dollars) on page 14 of the Analysis of the FY 2012 Defense Budget by Todd Harrison and the Center for Strategic and Budgetary Assessments written July 16, 2011.

$$\sum_{v=1}^{13}\sum_{p=1}^{5} c_v x_{v,p} \leq \$271,104 \qquad (2)$$

Similarly, most commands, regardless of type, i.e., cruiser, destroyer, NAVFAC, aviation squadron, rarely turn funds back into their Type Commander (TYCOM) or entity that distributes their funding as requirements generally exceed available funding. A minimum budget in this case is needed to prevent the model from optimizing to $0.00 and 0 vehicles. The amount of $135,552 was established for the minimum; that is 50% of the maximum budget. Equation 3 gives the minimum budget constraint.

$$\sum_{v=1}^{13}\sum_{p=1}^{6} c_v x_{v,p} \geq \$135,552 \qquad (3)$$

2. Maximum and Minimum Number of Vehicles by Priority Level

The maximum number of vehicles as an aggregate over each priority, K_p^{max}, is the TRIO established allowances if all requirements are filled and a budget of 100% and COL 1 were allowed; this is 100% fill rate. The minimum, K_p^{min}, was established by analyzing the lowest numbers found, by priority, on the in-house analysis conducted. The author felt safe in assuming that that was their minimum numbers of vehicles and the maximum level of risk that CFAS was willing to accept. Equations 4 and 5 give the maximum and the minimum number of vehicles in the priority.

$$\sum_{v=1}^{13} x_{v,p} \leq K_p^{max} \text{ for all } p \qquad (4)$$

$$\sum_{v=1}^{13} x_{v,p} \geq K_p^{min} \qquad (5)$$
$$\text{for all } p$$

3. Maximum and Minimum Number of Vehicles by Type

Analogous to K_p^{max} and K_p^{min}, the maximum number of vehicles by type, Q_v^{max}, is the TRIO established allowances. Reviewing the NMC local assessment done, and how the data presented itself, an acceptable distinct lower limit on the fill rate percentage occurred. That lower tolerance on an aggregate level was at the 50% mark, and at the individual vehicle level, deduced and an assumption made based on budget and cost of each vehicle. For example, on Priority 5 vehicles, it was clear that 50% of authorized (TRIO established) vehicles was the most risk that was willing to be assumed. More specifically, if 22 vehicles were authorized, PWO did not feel comfortable dropping below 11 vehicles in that priority. Thus, 11 was set as the minimum. The minimum, Q_v^{min}, was established via inference and assumptions deduced from the in-house analysis conducted. Equations 6 and 7 give the maximum and the minimum number of vehicles by type.

$$\sum_{p=1}^{6} x_{v,p} \leq Q_v^{\text{max}} \quad \text{for all } v \tag{6}$$

$$\sum_{p=1}^{6} x_{v,p} \geq Q_v^{\text{min}} \quad \text{for all } v \tag{7}$$

4. Fill Rate

Fill rate was needed to establish which COL a certain priority level would achieve. The variables y_p, defined previously, must therefore be constrained to equal the calculated fill rates as presented in Equation 8:

$$y_p = \frac{\sum_{v=1}^{13} x_{v,p}}{K_p^{\text{max}}} \quad \text{for all } p \tag{8}$$

where $K_p^{\text{max}} = $ fully stocked; $\sum_{v=1}^{13} x_{v,p} = $ current stock

5.   COL Determination

The COL drives this entire research project. NAVFAC has established that all commands will maintain a COL 4 and will be funded to 67 %. The maximization of the objective function can only be achieved by honoring the constraint of maintaining an overall COL 4. To calculate the overall COL level, it must be determined which COL level range each value of y_p falls within. Thus, the following constraints allow each $S_{p,l}$, variable to be 1 only if the calculated fill rate value y_p is within the upper and lower limits on the range for COL level l; $B_{p,l}^U$ and $B_{p,l}^L$ are the upper range and lower range thresholds, respectively. $S_{p,l}$, can be seen in Equations 9 and 10.

$$S_{p,l} \leq 1 + (B_{p,l}^U - y_p) \text{ for all } p \text{ and } l \tag{9}$$

$$S_{p,l} \leq 1 + (y_p - B_{p,l}^L) \text{ for all } p \text{ and } l \tag{10}$$

The COL determination, or more specifically, the lines of demarcation between the COLs (the $B_{p,l}^U$ and $B_{p,l}^L$ values), presented another challenge; incongruence occurred in two CNIC disseminated COL rage matrixes. More specifically, the CNIC promulgated COL percentages used for in-house analysis ironically do not align 100% with the CNIC COL rainbow chart (Figures 4 and Appendix A). As was the case with the weighting factors, the author used the scale employed during the Fall 2011 internal assessment and analysis of NMC for continuity and greatest integration of existing tools to be incorporated into the model developed. Figure 7 shows in detail the $B_{p,l}^U$ and $B_{p,l}^L$ values used in the model.

$B_{p,l}$	
1	1
0.900000000000000	0.999999999999999
0.000000000000000	0.899999999999999
0.970000000000000	1
0.850000000000000	0.969999999999999
0.670000000000000	0.849999999999999
0.000000000000000	0.679999999999999
0.890000000000000	1
0.800000000000000	0.889999999999999
0.560000000000000	0.799999999999999
0.000000000000000	0.559999999999999
Lower	Upper

Figure 7. $B_{p,l}$ Upper and Lower Ranges

In addition to there being limits on aggregate numbers of vehicle per priority, and total numbers of vehicles of each type, there are also limitations on which vehicle types, and how many vehicles of each type, can be in each priority. Thus, Equation 11 was established as

$$x_{v,p} \leq M(a_{v,p}) \text{ for all } v \text{ and } p \tag{11}$$

where the value $M(a_{v,p})$ will be the maximum possible allowance of each vehicle type in each priority. Many instances occur where $M(a_{v,p})$ will be 0; in those instances, a vehicle is not "allowed" in that priority.

The weighting factor, W_p, was the final constraint needed, which also factors into determining the COL required. During initial analysis, it seemed that the weighting factors in Figure 4 were arbitrarily done and that any weighting factors would be adequate as long as a scale existed, whether it be a 1–4 scale with 1 being assigned to COL 1 and so on through COL 4 or a scale of 0-5 with 5 being assigned to COL 4 and 0 to priority group with no allowance. On further reflection however, it did seem that the scale currently in use (Figure 4) was in fact a scale of weighting factors not arbitrarily assigned. The weighting factor scale applied when NAVFAC Sasebo did an in house

assessment of NMC found in Figure 4. The author applied that scale for continuity and maximum integration of what is currently used to the model developed. It should be noted that the research as to how the weighting factors were established was beyond the scope of this project. Equations 12–18 illustrate how the weighting factor for each priority level was calculated.

$$W_p = \text{weighting factor for each } p \tag{12}$$

$$W_p = 10 - 1.25 S_{1,1} - 2.75 S_{1,2} - 3 S_{1,3} \tag{13}$$

$$W_2 = 10 - .5 S_{2,1} - 2 S_{2,2} - 4 S_{2,3} - 7 S_{2,4} \tag{14}$$

$$W_3 = 10 - .5 S_{3,1} - 2 S_{3,2} - 4 S_{3,3} - 7 S_{3,4} \tag{15}$$

$$W_4 = 10 - .5 S_{4,1} - 2 S_{4,2} - 4 S_{4,3} - 7 S_{4,4} \tag{16}$$

$$W_5 = 10 - .5 S_{5,1} - 2 S_{5,2} - 4 S_{5,3} - 7 S_{5,4} \tag{17}$$

$$W_6 = 10 - .5 S_{6,1} - 2 S_{6,2} - 4 S_{6,3} - 7 S_{6,4} \tag{18}$$

The above equations will automatically generate the correct weighting value for each priority based on the CNIC established weighting factors seen previously in Chapter IV. To have just one constraint in the model, the author algebraically combined all the individual weighting factors into one equation, which is seen as Equation 19.

$$W_1 + W_2 + W_3 + W_4 + W_5 + W_6 \leq 4.99 * 6 \tag{19}$$

Equation 20 enforces the overall COL being at a COL 4 level by ensuring that the average of the weights is less than or equal to 4.99 (as specified in Figure 5).

E.   OTHER CHALLENGES AND ASSUMPTIONS

The above constraints address several challenges and assumptions; however, a few still need to be addressed—broad application of the model, suitability for other tenant commands, and network constraints.

1.   Broad Application of Optimizing Vehicles

The goal of the research was ultimately to develop a model that could be broadly applied to optimizing vehicles throughout the region. That said, any decrease in vehicle allocations to a tenant command would cause certain risks to be assumed and trade-offs that may occur. At times, it is not as simple as a black and white solution on paper. As such, any model developed would need to be modified based on other location factors that might vary in the region, specifically, more hilly terrain, a remote location, etc. In cases in which conditions and requirements are similar or identical, then data for another location could be used to feed into the basic model given that the overall methodology should be able to be transferred.

2.   Suitability for Other Tenant Commands

To simplify the model as a proof of concept, the author looked solely at NMC "B" pool vehicles in Sasebo due to the amount of data on hand, all vehicle inventories from January 2011 to December 2011, and also the internal assessment. Since this model is highly customized, and tailored specifically for analysis of the vehicles assigned to NMC in Sasebo, it is not suitable as it stands currently for application to other tenant commands. However, the methodology used in this model could be leveraged for other tenant commands.

3.   Network Constraints

The biggest challenge in developing the model was considering that, should the model become too large and cumbersome for regular Solver Basic in Excel to compute a solution, it would then need to be run and calculated on Solver Premium for Excel. Basic solver can handle up to 100 decision variables and 200 constraints while Solver Premium can handle up to 8,000-decision variable and 2,000 constraints. NMCI and OneNet, the Navy's two operating systems for the contiguous United States (CONUS) and Far East, respectively, do not allow Premium Solver to be authorized software; this factor greatly constrained the size of the model. With the 13 vehicles just for NMC, if all six priorities in the model were established, three of which are not used/authorized for NMC, the

maximum allowable variables and constraints were exceeded for Solver Basic; thus, the model was modified to include only those priorities that NMC is authorized to use, priorities 1, 3, and 5. Once this modification was made, the model was well within parameters for Basic Solver; this modification was done to allow for transportability to CFAS for use on their network. As this modification changes the index p to equal only 1, 3, and 5 in the model, this reduces the total number of decision variables and constraints, and also changes Equation 19. The new index of p and the modified constraint are shown in Table 5 and Equation 20.

$p=$ Priority Level	
p	Priority Level
1	1
3	3
5	5

Table 5.   A Revision of Table 2 for Priorities 1, 3, and 5 only.

$$W_1 + W_3 + W_5 \leq 4.99 * 3 \tag{20}$$

F.   IMPLEMENTATION OF MODEL

The author implemented this model using Basic Solver and setting all $x_{v,p}$ to integers so as to avoid a result of a fractional vehicle, and all $S_{p,l}$ to binary to give one and only one COL per priority. Once the integral constraints were introduced, a sensitivity report was no longer an option. As previously mentioned, Excel and Solver were utilized to implement the model developed. The model built for tenant command NMC allowed the author to ensure that not only the formulation of the model was correct, but also that it was logical before any further future models would be developed.

G.   SUMMARY

This chapter focused on model formulation in words and algebra, model implementation as a proof of concept in Microsoft Excel, as well as challenges not explained by the constraints. The next chapter discusses the results of the model and the variations of the model.

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VI. RESULTS

The model was run for nine scenarios. In the first two scenarios, the number of vehicles was maximized, and in the remaining seven scenarios, costs were minimized. In each scenario, the model was run with the TRIO established maximum number of vehicles authorized as a constraint along with the minimums discussed in Chapter V. The results of the optimal solutions were then compared to the in-house analysis done in Fall 2011 by Sasebo to see how similar or dissimilar the results between the two came out to be.

A. MODEL RUN AS MAXIMIZING THE NUMBER OF VEHICLES

The model was initially run with the established budget of $271,104; however, no feasible solution could be found. As a result, the author relaxed the budget constraint to $285,000 and ran solver to maximize the number of vehicles using the TRIO established maximum of 37. The resulting optimal mix was 24 vehicles; both results maximize the number of the vehicles while still remaining within the bounds of the constraints as established. These scenarios—with a maximum of 37 vehicles and the objective of maximizing the number of vehicles while maintaining COL 4—were run twice and produced two different mixes with both obtaining an optimal number at 24 vehicles. More detail is provided in Figures 8 and 9, which show the two different mixes, as well as the resulting budget when the budget threshold was relaxed. Figure 9 is the TRIO authorized maximums.

	0319-0J	0319-MJ	0329-MJ	0330-0J	0343-0J	0603-0J	0605-0J	0614-0J	0636-0J	0816-00	0832-00	0862-00	8254-00	
Priority 1	0	0	0	0	2	0	0	1	1	2	1	1	2	10
Priority 3	0	0	1	0	0	0	0	1	0	0	0	0	0	2
Priority 5	3	0	1	2	0	2	1	2	1	0	0	0	0	12
TOTALS	3	0	2	2	2	2	1	4	2	2	1	1	2	24

Figure 8.   Scenario 1 Resulted in an Aggregate Cost of $278,976

	0319-0J	0319-MJ	0329-MJ	0330-0J	0343-0J	0603-0J	0605-0J	0614-0J	0636-0J	0816-00	0832-00	0862-00	8254-00	
Priority 1	0	0	0	0	2	0	0	1	1	2	1	1	2	10
Priority 3	0	0	1	0	0	0	0	1	0	0	0	0	0	2
Priority 5	2	0	1	3	0	2	1	2	1	0	0	0	0	12
TOTALS	2	0	2	3	2	2	1	4	2	2	1	1	2	24

Figure 9.   Scenario 2 Resulted in an Aggregate Cost of $281,088

The differences in these two scenarios occur with the first four columns. Scenario 1's optimal mixture was 3 compact 4x2 cargo trucks (0319-0J) and 2 passenger vans (0330-0J) while Scenario 2 produces an optimal mixture of 2 compact 4x2 cargo trucks and 3 passenger vans; costs of each are $5,568 and $7,680, respectively. This small change is what produced the two different aggregate costs.

B.   MODEL RUN AS MINIMIZING COSTS WITH NO BUDGET

For comparison to the first two scenarios, the author then decided to see if running the model under a third scenario in which the objective was changed to a cost minimization and the maximum number of vehicles was set to the optimal solution found in the first two scenarios, would produce different results from when vehicles were maximized as the objective of the model. The objective function then changed to what is seen in Equation 21, which calculates the total cost.

$$\text{Minimize} \sum_{v=1}^{13} \sum_{p=1}^{6} C_v x_{v,p} \tag{21}$$

In this scenario, the budget was set at $3.5 million, which essentially removed the budget. The goal was to see what outcome would result with no budget at all. The results obtained reflected 22 vehicles at a cost below $271,104. The mix of vehicles and the resulting costs/budget are detailed in Figure 10.

	0319-0J	0319-MJ	0329-MJ	0330-0J	0343-0J	0603-0J	0605-0J	0614-0J	0636-0J	0816-00	0832-00	0862-00	8254-00	
Priority 1	0	0	0	0	2	0	0	1	1	1	1	1	2	9
Priority 3	0	0	1	0	0	0	0	1	0	0	0	0	0	2
Priority 5	2	0	1	2	0	2	1	2	1	0	0	0	0	11
TOTALS	2	0	2	2	2	2	1	4	2	1	1	1	2	22

Figure 10.   Scenario 3 Resulted in an Aggregate Cost of $269,568

C. SCENARIOS RUN AS COST MINIMIZATION AND CONSTRAINING AGGREGATE NUMBER OF VEHICLES TO A FIXED VALUE

In these next scenarios, the author added a constraint specifying the aggregate number of vehicles and minimized the cost; aggregates were set at four different levels (22, 23, 24, and 25), adding four additional scenarios. The added constraint for these additional scenarios is shown immediately below in Equation 22.

$$\sum_{v=1}^{13}\sum_{p=1}^{6} x_{v,p} = n \text{ where } n \text{ is set to 22, 23, 24, and 25, respectively.} \qquad (22)$$

Scenarios of 23, 24, and 25 aggregate vehicles were run twice as the precedent had been set with the maximization scenarios, which produced two different optimality mixtures. Thus, the author needed to investigate if this held true for minimizing costs as well. These scenarios were done to establish a cost frontier for NMC at CFAS. A cost frontier is a methodology used to incorporate the determinants of cost inefficiency explicitly; empirical results are the product of a cost frontier.[91]

1. Scenario 3: Minimize Costs with Aggregate Number of Vehicles at 22

This scenario was run to see if setting the aggregate number of vehicles to an exact value of 22 and minimizing the costs would produce a different mixture of vehicles in the optimal result. As mentioned previously with other aggregate total numbers of vehicles, this second run of 22 vehicles was run for consistency and to investigate if multiple optimal results, as seen with maximization and 24 vehicles, would occur when minimizing costs and having 22 vehicles.

Comparing Figure 11 with Figure 10, no difference occurred in either the resulting cost/ budget with minimizing costs or the mixture of vehicles when the exact value of the total number of vehicles across all priorities was set to 22.

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[91] Masayo Sakata, "A Cost Frontier Approach for Estimating the Determinants of Cost Inefficiency in Japanese Fire Protection Management," *Journal of Asian Economics* 15, no. 3 (July 10, 2004): 579–590, http://www.sciencedirect.com/science/article/pii/S1049007804000600.

	0319-0J	0319-MJ	0329-MJ	0330-0J	0343-0J	0603-0J	0605-0J	0614-0J	0636-0J	0816-00	0832-00	0862-00	8254-00	
Priority 1	0	0	0	0	2	0	0	1	1	1	1	1	2	9
Priority 3	0	0	1	0	0	0	0	1	0	0	0	0	0	2
Priority 5	2	0	1	2	0	2	1	2	1	0	0	0	0	11
TOTALS	2	0	2	2	2	2	1	4	2	1	1	1	2	22

Figure 11.   Scenario 3 Resulted in an Aggregate Cost of $269,568

2.   Scenario 4: Minimize Costs with Aggregate Number of Vehicles at 23

The next step in the minimization of costs was to investigate what the costs and optimal vehicle mixture would be if the aggregate total was set to 23. In this scenario, the right hand side of Equation 22 is changed to 23 in the model.

Figure 12 gives the details of the optimal mixture of 23 vehicles, as well as the resulting cost/budget.

	0319-0J	0319-MJ	0329-MJ	0330-0J	0343-0J	0603-0J	0605-0J	0614-0J	0636-0J	0816-00	0832-00	0862-00	8254-00	
Priority 1	0	0	0	0	2	0	0	1	1	2	1	1	2	10
Priority 3	0	0	1	0	0	0	0	1	0	0	0	0	0	2
Priority 5	2	0	1	2	0	2	1	2	1	0	0	0	0	11
TOTALS	2	0	2	2	2	2	1	4	2	2	1	1	2	23

Figure 12.   Scenario 4 Resulted in an Aggregate Cost of $273,408

3.   Scenario 5: Second Run of Minimize Costs with Aggregate Number of 23

As was done previously, the author ran the model again to see if a different mixture of vehicles would occur that would be optimal. As was the case with running a second scenario with an aggregate of 22 vehicles, the second running of a scenario set at 23 produced no changes.

4.   Scenario 6: Minimize Costs with Aggregate Number of Vehicles at 24

The next logical step was to run the model with a scenario where costs were minimized and the aggregate number of vehicles was set to 24. In this scenario, the right hand side of Equation 22 is changed to 24 in the model.

The author was especially interested to see what this scenario would produce since 24 was the total number of vehicles in the solution to the original vehicle

maximization model When the aggregate number of vehicles was set to 24, and the model was set to minimize costs, the results in Figure 13 were produced.

	0319-0J	0319-MJ	0329-MJ	0330-0J	0343-0J	0603-0J	0605-0J	0614-0J	0636-0J	0816-00	0832-00	0862-00	8254-00	
Priority 1	0	0	0	0	2	0	0	1	1	2	1	1	2	10
Priority 3	0	0	1	0	0	0	0	1	0	0	0	0	0	2
Priority 5	2	0	2	2	0	2	1	2	1	0	0	0	0	12
TOTALS	2	0	3	2	2	2	1	4	2	2	1	1	2	24

Figure 13.   Scenario 6 Resulted in an Aggregate Cost of $277,824

The results differ in the first three columns from the two scenarios from when the model was set to maximize vehicles. In the first scenario of maximizing, Solver produced optimal results of 3 compact cargo 4x2 trucks (0319-0J) and 2 panel truck vans (0329-MJ), while in the second maximization of vehicles, Solver said optimality was achieved with 2 compact cargo 4x2 trucks and 2 panel truck vans. The costs are $5,568 and $4,416, respectively, and are what gives the different in aggregate total costs for 24 vehicles. These results show that there a number of combinations of vehicles that satisfy the constraints with 24 total vehicles, and the way to find the most cost-effective combination is to solve this cost minimization version of the model.

5.   Scenario 7: Second Run of Minimize Costs with Aggregate Number of 24

When this scenario was run, it did in fact produce a different mixture of optimal vehicles showing there are multiple optimal solutions to this model (multiple combinations of 24 vehicles that can satisfy all constraints and achieve the optimal lowest cost of $277,824). The difference in the optimal mixture occurs with in the first three columns. More specifically, the difference occurs with 0319-MJ and 0329-MJ, which are a cargo truck 4x2 mini and a panel truck van, respectively. As previously seen in Chapter V, these two vehicles cost the same, $4,416. Figure 14 presents the in-depth results of this scenario.

	0319-0J	0319-MJ	0329-MJ	0330-0J	0343-0J	0603-0J	0605-0J	0614-0J	0636-0J	0816-00	0832-00	0862-00	8254-00	
Priority 1	0	0	0	0	2	0	0	1	1	2	1	1	2	10
Priority 3	0	1	0	0	0	0	0	1	0	0	0	0	0	2
Priority 5	2	0	2	2	0	2	1	2	1	0	0	0	0	12
TOTALS	2	1	2	2	2	2	1	4	2	2	1	1	2	24

Figure 14.   Scenario 7 Resulted in an Aggregate Cost of $277,824

6.   Scenario 8: Minimize Costs with Aggregate Number of Vehicles at 25

The next logical step from 24 vehicles as an aggregate was to run the model with a scenario in which cost is minimized and the aggregate number of vehicles was set to 25. In this scenario, the right hand side of Equation 22 is changed to 25 in the model.

When running this scenario, the author had to relax the budget to get Solver to find an optimal solution. The budget was relaxed incrementally by $5,000 at a time until the aggregate maximum budget in the model was $340,000. This scenario also increases the number of cranes (8245-00) to three. All previous models kept this vehicle at two. The cost of a crane is $57,600, and was thus, a major driving factor in the results aggregate cost. The results in Figure 15 give the specifics of minimizing costs with an aggregate number of vehicles set at 25.

	0319-0J	0319-MJ	0329-MJ	0330-0J	0343-0J	0603-0J	0605-0J	0614-0J	0636-0J	0816-00	0832-00	0862-00	8254-00	
Priority 1	0	0	0	0	2	0	0	1	1	2	1	1	3	11
Priority 3	0	1	0	0	0	0	0	1	0	0	0	0	0	2
Priority 5	2	0	2	2	0	2	1	2	1	0	0	0	0	12
TOTALS	2	1	2	2	2	2	1	4	2	2	1	1	3	25

Figure 15.   Scenario 8 Resulted in an Aggregate Cost of $335,424

7.   Scenario 9: Second Run of Minimize Costs with Aggregate Number of 25

As was the case when the author did a second run with 24 total vehicles, this scenario also produced a different mixture of optimal vehicles, and the total costs/budget remained the same. The difference in the optimal mixture occurs with in the first three columns. More specifically, the difference occurs with 0319-MJ and 0329-MJ, which are a cargo truck 4x2 mini and a panel truck van, respectively.

	0319-0J	0319-MJ	0329-MJ	0330-0J	0343-0J	0603-0J	0605-0J	0614-0J	0636-0J	0816-00	0832-00	0862-00	8254-00	
Priority 1	0	0	0	0	2	0	0	1	1	2	1	1	3	11
Priority 3	0	0	1	0	0	0	0	1	0	0	0	0	0	2
Priority 5	2	0	2	2	0	2	1	2	1	0	0	0	0	12
TOTALS	2	0	3	2	2	2	1	4	2	2	1	1	3	25

Figure 16. Scenario 9 Resulted in a Budget of $335,424.

D. ANALYSIS

The previous sections addressed the optimal aggregate number of vehicles and their associated costs. The author compared the output of the model and the scenarios to the original COAs developed by the PWO in Fall 2011, discussed a cost evaluation of the scenario results in comparison to the budget PWO established, and showed the fill rate of each scenario by priority for each scenario.

1. Comparison of Optimization Results to PWO's COAs

The results of the scenarios were compared to the heuristic analysis performed in Fall 2011 to see if any differences arose. The comparison showed that when the objective was set to maximizing the total number of vehicles, the solution exactly matched two of the COAs derived by the PWO from the internal manual evaluation previously done on the basis of aggregate number of vehicles. The two COAs are shown in Figures 17 and 18.

Priority	IO	On-Hand	Fill rate %	Mini COL	Wght	COL
1	11	9	81.82%	3	3	
2						
3	4	3	75.00%	3	6	4
4						
5	22	12	54.55%	4	3	
6						
	37	24		3.333333	4	

Figure 17. In-house Sasebo COA 1 Done in Fall 2011

Priority	IO	On-Hand	Fill rate %	Mini COL	Wght	COL
1	11	10	90.91%	2	6	
2						
3	4	2	50.00%	4	3	4
4						
5	22	12	54.55%	4	3	
6						
	37	24		3.333333	4	

Figure 18.   In-house Sasebo COA 2 Done in Fall 2011

In addition to the above two COAs, a third COA was also done that results in an aggregate of 27 vehicles. However, based on the resulting aggregate costs of the optimization model when run previously as a minimization of costs with aggregate cost being $335,424 for 25 vehicles, a $64,320 increase occurred over the budget set by PWO The author did not investigate that COA. The rational was that the resulting budget at 27 vehicles would have far exceeded what was feasible for CFAS for NMC based on the results seen for 25 vehicles. This same rational holds true for not investigating 26 vehicles. Maximizing the model to give the maximum number of vehicles possible while still attaining COL 4 resulting in 24 vehicles, which exactly matched two of the three COAs PWO, does seem to show that minimizing costs is a better route to take.

The effect of changing from a scenario that maximizes the number of vehicles to a scenario that minimizes the costs considerably impacts the outcome. When the objective is to minimize the costs, the aggregate budget for the solution was $1,536 lower than the allocated budget—a very significant outcome when budgets are tight and fiduciary responsibility is of utmost importance. While the savings may be a seemingly small number, it is a small representative example and can be leveraged to other, larger commands. The switch to an objective that minimizes cost not only shows viable proof of concept but also the fact that the model can provide a valuable bias free decision-making tool.

2. Cost Evaluation and Fill Rate

To be able to provide a more informed analysis, the author wanted to take the results and compare them to the current budget for this fiscal year to determine the difference in over/under budget. The primary reason was to see how much the total costs in relation to the number of vehicles affected impacted the fill rate and whether any significant efficiency was gained/lost. Figure 19 shows the change in total costs in relation to the established budget while Figure 20 shows the total costs with a breakdown of vehicles by priority and aggregate, as well as the fill rate.

		Delta $	Delta %	Change
Current Budget	$ 271,104			
Maximize Vehicles (24)	$ 278,976	$ 7,872	2.90%	INCREASE
Maximize Vehicles (24)	$ 281,088	$ 9,984	3.68%	INCREASE
Minimized Costs (22)	$ 269,568	$ (1,536)	0.57%	Decrease
Minimized Costs (23)	$ 273,408	$ 2,304	0.85%	INCREASE
Minimized Costs (24)	$ 277,824	$ 6,720	2.48%	INCREASE
Minimized Costs (25)	$ 335,424	$ 64,320	23.73%	INCREASE

Figure 19.   Costs Analysis of All Scenarios

	Numbers of Vehicles by Priority				Fill Rate		
Total $	Priority 1	Priority 3	Priority 5	Total	Priority 1	Priority 3	Priority 5
$ 269,568	9	2	11	22	81.82%	50.00%	50.00%
$ 273,408	10	2	11	23	90.91%	50.00%	50.00%
$ 278,976	10	2	12	24	90.91%	50.00%	54.55%
$ 281,088	10	2	12	24	90.91%	50.00%	54.55%
$ 277,824	10	2	12	24	90.91%	50.00%	54.55%
$ 277,824	10	2	12	24	90.91%	50.00%	54.55%
$ 335,424	11	2	12	25	100.00%	50.00%	54.55%
$ 335,424	11	2	12	25	100.00%	50.00%	54.55%

Figure 20.   Consolidated Results

Based on Figures 19 and 20, it can be seen that an increase of almost 24% in the budget does not gain much more efficiency, and that efficiency really comes down to adding a third crane—a very expensive proposition. At the time the NMC budget was

established, CFAS had already determined that they could assume the risk of decreasing from three to two cranes to meet mission requirements. Similarly, not much is lost with having 22 vehicles; the difference comes from decreasing a trailer when compared to the results of having 23 vehicles. When comparing that number to the 54.55% fill rate in priority 5 for all other scenarios, as well as scenarios of 24 and 25 vehicles, the difference comes down to a passenger truck van or a compact 4x2 cargo truck both of which costs the same at $4,416. The numerical results seem to indicate that a) the level of service provided does not change significantly when looking at 22, 23, or 24 vehicles, and b) given the increase in costs, even if only a modest increase in the resulting aggregate budget occurs, not much more of a benefit is provided nor does it seem to impact meeting mission requirements negatively. Graphs 1 and 2 are a visual representation.
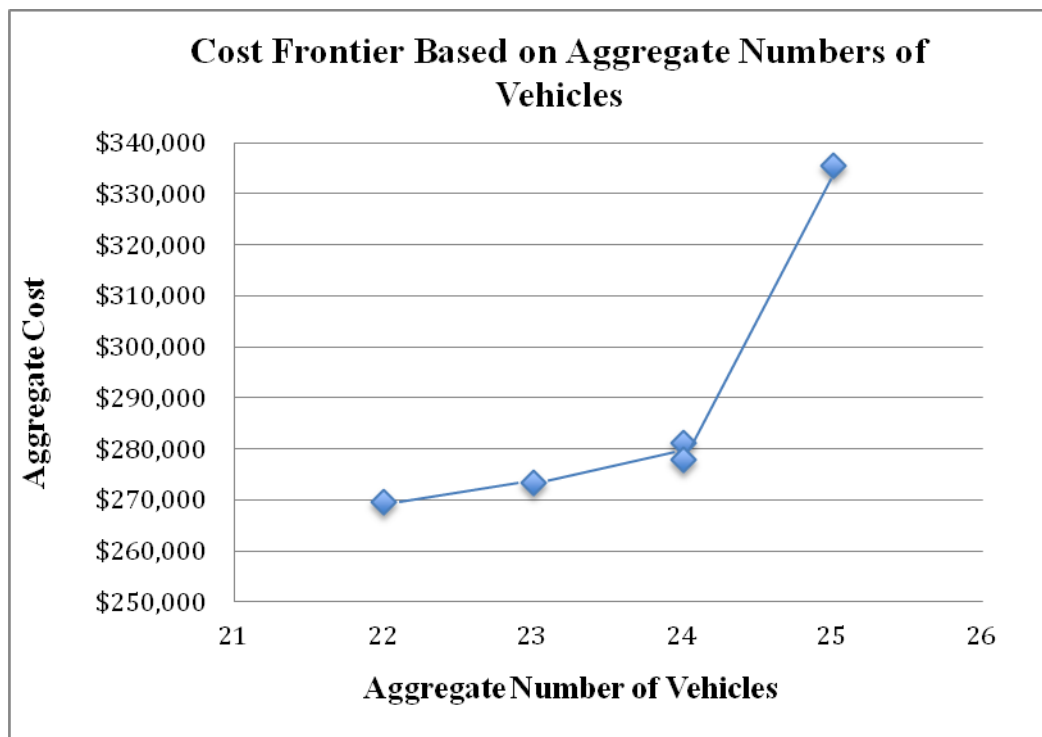
Graph 1.　　Cost Frontier Over Aggregate Number of Vehicles Across All Scenarios
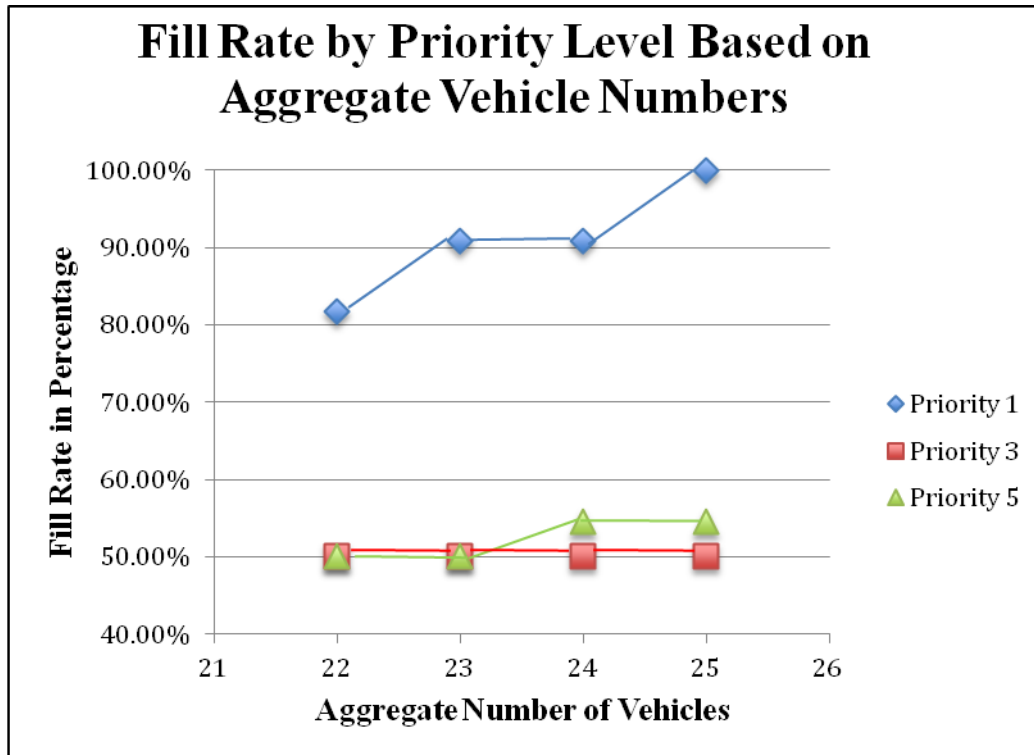
Graph 2.   Fill Rate by Priority Level Over Aggregate Number of Vehicles Across All
Scenarios

E.   SUMMARY

This chapter emphasized the examination of the results of the model and the scenarios run. The author highlighted the changes that resulted from switching from maximization scenarios to the minimization of costs scenarios and compared those to the COAs PWO developed previously. Last shown were the fill rates, and how they relate to the total costs that the optimal solutions provide in relation to the budget established. The final chapter concludes with conclusions, recommendations, and areas for potential further investigation/research.

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VII. CONCLUSIONS AND RECOMMENDATIONS

This thesis ultimately sought to provide a mathematical model that could be implemented into the decision-making process for vehicle pool management by constructing a plug and play model for any tenant command at Commander Fleet Activities Sasebo, Japan. By addressing both an objective that maximized the number of vehicles and an objective that minimized the costs through various scenarios, the author was able to show how efficiency could be increased through cost savings.

While it was demonstrated that the application of a mathematical optimization approach to vehicle management could aid in the decision-making process, developing a model for all tenant commands was infeasible due to two major factors. First, the sheer size of the model with all constraints and variables exceeded what Basic Solver could handle. Second because of the number of constraints and variables, any model developed would be required to be run on Premium Solver, which is not authorized by NMCI or OneNet. However, with proper modification, for example, by removing unused priority levels from other tenant commands, similar models could be developed for CFAS.

A. MODEL LIMITS

This model does not have the ability to estimate the effects that changes in policy will have nor does it have the ability to estimate the effect that implementation of new policy will have. The user will have to consider those when analyzing the results that the model produces. Additionally, the model is also limited by the data input and utilized. Data utilized was based on historical data and any changes to that data, whether based on budget, or an increase of authorized COL as an aggregate over all p, would not be captured.

B. RECOMMENDATIONS

The author included many relevant factors into the model, thus creating a valuable decision-making tool that incorporated all aspects of the analysis tool already in place and in use at the time the research was conducted and data collected. As previously mentioned, the requirement generated with the proof of concept to have the full unmodified model run on Premium Solver presented an unanticipated obstacle. Premium Solver is a software program not currently authorized on either NMCI or OneNet. The author recommends that Premium Solver be authorized for use on NMCI and OneNet as any costs of software could easily and quickly be recouped by the potential cost savings of correctly optimizing vehicle pools and objectives that have been at the forefront since the mid-1980s. Thus, the right sizing of the vehicle pools could be accomplished through methods other than simple budget reductions and unproven heuristics that exacerbate current inefficiencies. Another recommendation is that the model be developed in its modified form and implemented to aid in the decision-making process, if possible.

C. AREAS FOR POTENTIAL FUTURE RESEARCH

This thesis focused on taking certain pieces of information as fact since further research that delved into how this data was derived or constructed was beyond the scope of this paper. That said, other options for analysis were also formulated during the course of the research that could provide a potential alternatives to this assessment. Areas for future research include the following.

- How does CNIC choose the weighting factors that it does on COL levels, the range of COL, and why is incongruence found between the two charts promulgated?

- Would it be possible to attain the COLs if different weighting factors were developed and assigned, and consequently, a different result range scale utilized or is the current weighting the best option?

- Does the TRIO effectively measure and analyze utilization when they perform a baseline? Is the TRIO using current industry standards to refine and hone their baseline assessments?

- If the needs vary by job and those needs determine vehicles, can a matrix or ratio be developed and implemented for use so that at any location with the same job and the same parameters will require the same equipment with established upper and lower bounds (a high/low limit) on the number of equipment (assets)?

- Could the implementation of "cockpit charts" similar to what the aviation community uses or a dashboard like TORIS/TFOM used by surface Navy, which give quick visual reference on performance, be added for reporting and self-analysis in between the TRIOs?

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		COL 1	COL 2 90%	COL 3 80%	COL 4 79^%
Priority 1	a. Mission Critical – Primary equipment used for immediate, full time, front ine support to put active ships/subs back in the water, put airplanes in the air, or load ordnance. b. Life/Safety – Primary equipment used for full time support to respond to life/safety emergencies	100-98% of Inventory Objective & Service Support	97-95% of Inventory Objective & Service Support	94-89% of Inventory Objective & Service Support	<89% of Inventory Objective & Service Support
Priority 2	a. Mission Essential Vehicles used for full time support for second tier functions supporting the front line mission critical functions b. Security or ATFP equipment used for primary full time patrols	100-95% of Inventory Objective & Service Support	94-90% of Inventory Objective & Service Support	89-78% of Inventory Objective & Service Support	<78% of Inventory Objective & Service Support
Priority 3	a. Special purpose equipment for response to environmental or property emergencies b. Administrative equipment for fire and security command responders c. Full time requirement to transport government property or access restricted areas.	100-92% of Inventory Objective & Service Support	91-85% of Inventory Objective & Service Support	84-67% of Inventory Objective & Service Support	<67 of Inventory Objective & Service Support
Priority 4	a. Pool Vehicles for multiple users with core functions, taxi, bus b. Equipment identified by regulatory requirement such as Ship's allotment, etc. c. Commanding Officer full time use for Navy presence to political events, mission critical support, local functions	100-91% of Inventory Objective & Service Support	90-82% of Inventory Objective & Service Support	81-64% of Inventory Objective & Service Support	<64 of Inventory Objective & Service Support
Priority 5	a. Backup & supplementary equipment for mission essential or mission critical functions (not full time use) b. Equipment used for other base support, inspections, quality of life	100-89% of Inventory Objective & Service Support	88-80% of Inventory Objective & Service Support	79-56% of Inventory Objective & Service Support	<56% of Inventory Objective & Service Support
Priority 6	a. Cost effective equipment for administrative functions, justified for business operation efficiency. b. IO that can be filled by other means with impacts to schedule or costs	100-86% of Inventory Objective & Service Support	85-75% of Inventory Objective & Service Support	74-46% of Inventory Objective & Service Support	<45% of Inventory Objective & Service Support

92 Information obtained from e-mail message to the author, Sasebo, December 4, 2012; COL Rainbow matrix.

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APPENDIX B.   TRIO INTERVIEW QUESTIONS[93]

INTERVIEW WORKSHEET
Activity Name:_____
UIC:_____

CNIC Funded -Yes or No:_____(If No, who funds your vehicles)
IMAP Core Business Model Program:
                    level 1:   _____
                    level 2:   _____
                    level 3:   _____
                    level 4:   _____

Name of Program Manager and phone number (print):_____

Name of Individual at activity and phone number:_____

Requirement (current or new):   _____

IO Functional Classification (list number 1, 2, 3, or 4):_____

1= Administrative (people moving, not directly work related)

2 = Supply Oriented (indirectly work related, the vehicle is used to transport cargo or supplies is support of the work being accomplished)

3 = Work Oriented (directly work related, e.g., PW work crews, equipment operators, etc.)

4 = Mission Essential (fire trucks, ambulances, airfield sweepers, aircraft refuelers, ordnance moving vehicles (vehicles used to support core functions of the base))

Current equipment utilized (Equipment Code and Description):   _____
USN or GSA Tag Number:_____

Primary Function: _____
                            _____
                            _____
                            _____
                            _____

Actual or expected annual mileage: _____
Actual or expected trips per day: _____

For the following questions, please provide additional data as necessary on separate sheet:

How many people does this vehicle support within the division/work center?   _____

How many people are transported in this vehicle, daily?   _____

List on-base areas that the vehicle is operated.   _____

Is the vehicle operated off base? (Y/N):   _____

Load/weight transported (list weight in pounds):   _____

Passengers transported (Number of individuals per trip to determine vehicle type required)_____

Could a non-CESE asset be used? e.g., electric vehicle, golf cart, etc. (Y/N)   _____

Can work be done via scheduled service, shuttle bus, taxi or C-pool service? (Y/N)_____
If **no**, explain why on a separate sheet.

Describe the impact to your mission if a vehicle can not be provided on a separate sheet.

To be completed by TEMC					
Recommendation					
TRIO IO: EC	_____	Navy	_____	Lease	_____

---

[93] Information obtained from e-mail message to the author, Sasebo, December 4, 2012; TRIO Blank Interview Worksheet.

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APPENDIX C.   IO DECISION MAKING PROCESS, VALID IO DETERMINATION FLOW CHART, UPDATED COL MATRIX[94]

```
                 IO Decision Making Process


Direct Mission Support  (e.g., FFE, CO's vehicle, etc)
Special Purpose - no IO, P-97, claimant funded. (this does not
include standard CESE, modified to be special purpose, this is
stuff bought as special purpose that can't be used for anything
else.)
Utilization
     # trips daily
     # annual miles (less than 8000ish, need to reconsider IO)
     # days/week
Environment
     Industrial - use SMVs, not centrally managed
     Acreage - 4x4s needed?
     Functional (air station/air field, naval station)
     Administrative (REDCOMs, etc)
Operating Area
     Confined (shipyard)
     Disbursed (weapons station)
Primary Function
     Administrative - people moving
     Supply - cargo hauling
     Work - direct work support (e.g., PW laborers)
     Mission - FFE, ambulance, ordnance handling, etc.
Other considerations
     # people in organization
     # people supported by vehicle
     # people generally transported per trip
     # trips/day
     # lbs transported per trip
     estimated daily mileage
Other options:
     C-pool/short-term rental
     Taxi
     Shuttle bus
     SMV
     POV
```
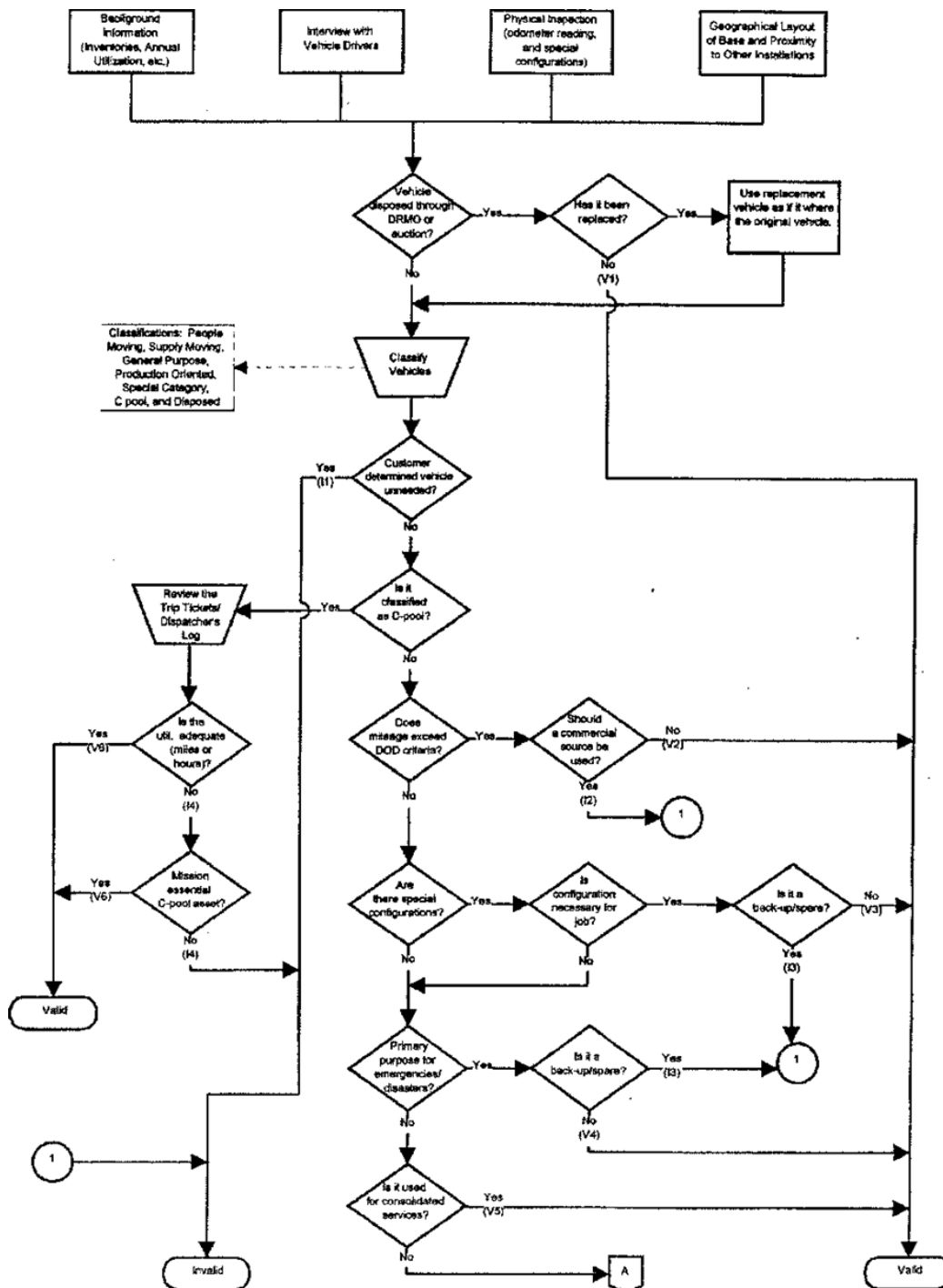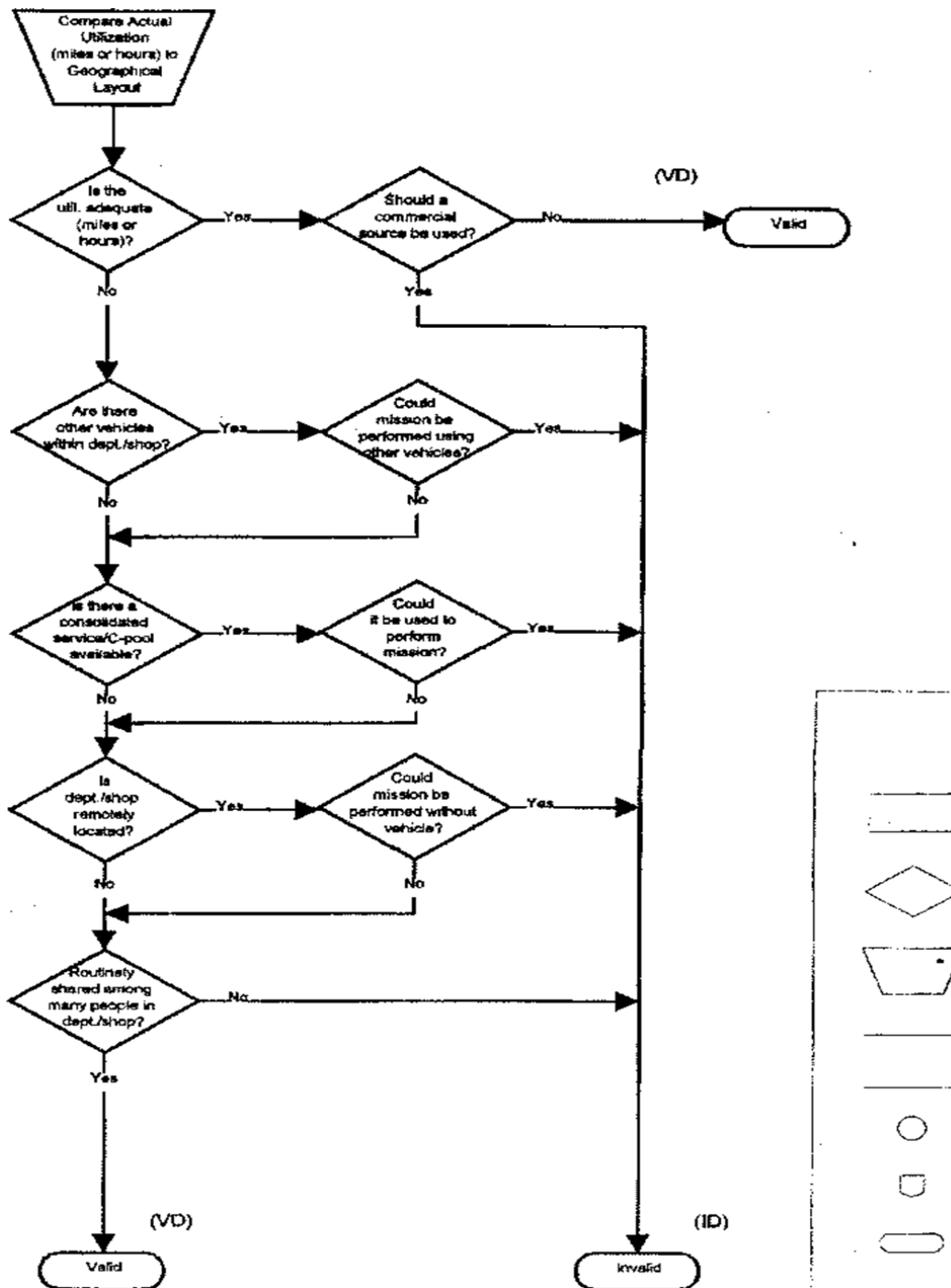
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94 PWO Sasebo, e-mail message to the author, December 4, 2011.

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APPENDIX D. VALIDATION FLOW CHART[95]

[95] Naval Audit Service report 030-98, "Management of Non-Tactical (Administrative) Transportation Vehicles," Exhibit E.

```
                    ┌─────────────┐
                    │ Compare Actual│
                    │  Utilization  │
                    │(miles or hours) to│
                    │  Geographical │
                    │    Layout     │
                    └──────┬──────┘
                           │
                           ▼
              ◇ Is the              ◇ Should a                    (VD)
              util. adequate        commercial                ╭──────────╮
              (miles or    ──Yes──▶ source be used? ──No─────▶│  Valid   │
              hours)?               ◇                          ╰──────────╯
              ◇
              │No                        │Yes
              ▼                          │
              ◇ Are there           ◇ Could                     │
              other vehicles        mission be                  │
              within dept./shop? ─Yes─▶ performed using ──Yes─▶ │
              ◇                     other vehicles?             │
              │No                   ◇                           │
              │                     │No                         │
              ▼◀────────────────────┘                           │
              ◇ Is there a          ◇ Could                     │
              consolidated          it be used to               │
              service/C-pool   ─Yes─▶ perform      ──Yes──────▶ │
              available?            mission?                     │
              ◇                     ◇                            │
              │No                   │No                          │
              ▼◀────────────────────┘                           │
              ◇ Is                  ◇ Could                      │
              dept./shop            mission be                   │
              remotely         ─Yes─▶ performed without ─Yes───▶ │
              located?             vehicle?                      │
              ◇                     ◇                            │
              │No                   │No                          │
              ▼◀────────────────────┘                           │
              ◇ Routinely                                        │
              shared among                                       │
              many people in  ──No──────────────────────────────▶
              dept./shop?
              ◇
              │Yes
              ▼                                                  ▼
            (VD)                                               (ID)
        ╭──────────╮                                      ╭──────────╮
        │  Valid   │                                      │ Invalid  │
        ╰──────────╯                                      ╰──────────╯
```

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APPENDIX E.   DETAILED TRIO PROCESS BY STEP

Step 1: Initiating the TRIO. The TRIO is initiated by the command receiving a TRIO announcement letter and an interview worksheet (Appendix B). More specifically this step is broken down into two procedures by role.

Product Line Management Office Representative:

1.   Schedule letter from NAVFAC beginning each fiscal year to coordinate with Base Support Vehicles and Equipment (BSVE) Program Manager specific timeframe for visit.

2.   Send Transportation Review of Inventory Objectives (TRIO) announcement letter from NAVFAC to region 60 days prior to the agreed upon visit date.

3.   Send the TRIO Interview sheet with the announcement letter.

4.   Collect assignment and utilization data prior to visit.

Regional BSVE Program Manager:

1.   Establish interview schedules for the Product Line Management Office (PLMO) team.

2.   Ensure completion of TRIO Interview sheets.

3.   Provide assignment and utilization data prior to PLMO visit.

Step 2: Conducting the TRIO. Again the procedures contained within this step are broken out according to the person responsible; the underlying documents for this step are the GAO Report, GAO-04-664, and the Naval Audit Service Report, 030-98, both were previously discussed in Chapter II.

Regional Program Manager:

1.   Articulate BSVE requirements for their particular program.

2.   Product Line Management Office Representative:

3.   Meet with Regional program managers to determine minimum vehicle and equipment requirements to meet mission.

4.   Determine the most efficient and effective means of providing transportation.

5.   Consider sub-pooling, Privately Owned Vehicles (POVs), shuttle/taxi service, slow moving vehicles, short-term rentals.

6.   Review annual utilization and whether local utilization targets have been established.

7.   Review Equipment Code (EC) 0905 slow moving vehicles – are centrally managed and have Inventory Objectives (IOs).

8.   Review the appropriated side of Morale, Welfare and Recreation (MWR).

9.   Request information from the most recent post validation study to help determine the number of patrol vehicles for security.

10.   Refer all requests for Fire Fighting Equipment (FFE) to Commander, Navy Installations Command (CNIC) Fire and Emergency Services.

11.   Focus on the A-O IOs because heavy equipment will be treated differently i.e., provided by the Facilities Engineering Command (FEC) as a service.

12.   Review IOs that are held at the FEC to support customers both CNIC resourced and non-CNI-resourced, including the FEC assets.

13.   Establish IOs based on fuel economy, alternative fuel requirements, utilization history and the factors cited above.

14.   Make sure to have on hand:

      a.   OPNAV INST tasking NAVFAC with Civil Engineering Support Equipment (CESE)

      b.   Government Accountability Office (GAO) Report 04-664

      c.   Naval Audit Report 030-98

Step 3: Follow-up to the TRIO. The guiding documents in step three are the IO decision-making process (Appendix D), the flow chart on how to determine a valid IO (Figure 4), an updated COL matrix (Figure 5), and an IMAP break down of what tenant command belongs to which IMAP level.

Product Line Management Representative:

1.	Enter TRIO data in applicable management information system.

2.	Assign a priority designation from the current CNIC COLs chart.

3.	Identify IO holder as the FEC.

4.	Identify IO generator as the installation that has the requirement.

5.	Identify 4 Installation Management Accounting Project (IMAP) levels for CNI-resourced requirements.

6.	Reflect IOs established during TRIO under the validated column.

7.	Reflect IO additions and deletions between TRIOs under interim column.

8.	Ensure the validated and interim IOs equal the total owned IO.

9.	Ensure IOs are not duplicated from one column to another.

Once the TRIO has concluded, a letter is sent to the region with the results either increasing or decreasing the IOs; if there is a decrease in IO then those vehicles are removed from utilization. At that point, the TRIO has completed for the triennial assessment. It is still incumbent upon the installation to do their annual assessments, which are in essence the same analysis that the TRIO does, except this is done in house and forwarded to the cognizant Echelon III for further upload into higher tier reporting systems.

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LIST OF REFERENCES

Balakrishnan, Nagraj, Barry Render, and Ralph Stair. *Managerial Decision Modeling with Spreadsheets* (2nd. ed.). Upper Saddle River, NJ: Prentice Hall, 2007.

Congressional Budget Office, "Estimated Impact of Automatic Budget Enforcement Procedures Specified in the Budget Control Act." September 12, 2011. CNIC//Commander Fleet Activities Atsugi. "About." (n.d.). https://www.cnic.navy.mil/Atsugi/About/index.htm.

———. "History." (n.d.). https://www.cnic.navy.mil/Atsugi/About/History/index.htm.

CNIC//Commander Fleet Activities Misawa. "About." (n.d.). https://www.cnic.navy.mil/Misawa/About/index.htm.

———. "Welcome to Naval Air Facility Misawa." (n.d.). https://www.cnic.navy.mil/Misawa/About/Command/index.htm.

———. "Welcome to Naval Air Facility Misawa." (n.d.). https://www.cnic.navy.mil/Misawa/index.htm.

CNIC//Commander Fleet Activities Sasebo. "Commander Fleet Activities Sasebo by Department." (n.d.). http://cnic.navy.mil/Sasebo/About/Departments/index.htm.

———. "FDNF Ships." (n.d.). http://cnic.navy.mil/Sasebo/About/FDNFShips/index.htm.

———. "Mission and Vision." (n.d.). http://cnic.navy.mil/Sasebo/About/MissionAndVision/index.htm.

———. "Tenant Command." (n.d.). http://cnic.navy.mil/Sasebo/About/TenantCommands/index.htm.

———.. "Visitor Information." (n.d.). http://cnic.navy.mil/Sasebo/InstallationGuide/VisitorInformation/index.htm.

———. "Welcome to Commander Fleet Activities Sasebo." (n.d.). http://cnic.navy.mil/Sasebo/index.htm.

CNIC//Commander Fleet Activities Yokosuka. "Mission and Vision." (n.d.). https://www.cnic.navy.mil/Yokosuka/About/MissionAndVision/index.htm.

Cyr, Phillip G. "Cost Analysis of Maintenance Programs for Pre-Positioned War Reserve Material Stock (PWRMS)." Master's thesis, Naval Postgraduate School, 2002. http://www.dtic.mil/dtic/tr/fulltext/u2/a405815.pdf.

Daniel, Lisa. "Carter Outlines Plane to Help Warfighter, Taxpayers." September 14, 2010. http://www.defense.gov/news/newsarticle.aspx?id=60852.

Department of Defense Regulation 4500.36-R. Management, Acquisition, and Use of Motor Vehicles. March 16, 2007. http://www.dtic.mil/whs/directives/corres/pdf/450036r.pdf.

"DoD's O&M funds are considered by many to be more discretionary than other types of defense appropriations." Appendix, 3 of Decision B-213137 by the Comptroller General of the United to the Honorable Bill Alexander, U.S. House of Representatives dated June 22, 1984.

GSA. U.S. General Services Administration. "FAST Data Center." (n.d.). http://www.gsa.gov/portal/content/102677.

Jiminez, David A., Jason B. Wamsley, and Nicholas E. Priscoe. "Optimizing the Ground Mobile Radio Basis of Issue for the U.S. Army Heavy Brigade Combat Team." MBA professional report, Naval Postgraduate School, 2011. http://edocs.nps.edu/npspubs/scholarly/MBAPR/2011/December/11Dec_Prisco_MBA.pdf.

Miles, Donna. "Carter: Budget Cuts Demand More DOD Buying Power." April 20, 2011. http://www.defense.gov/news/newsarticle.aspx?id=63633.

MWR. "Library MWR Program, Standards and Metrics." August 2005. http://navymwr.org/mwrprgms/librarystandards.pdf.

Naval Audit Service Report 030-98. "Management of Non-Tactical (Administrative) Transportation Vehicles." March 24, 1998.

NAVFAC P-300. "Management of Civil Engineering Support Equipment." September 2003. https://portal.navfac.navy.mil/portal/page/portal/docs/doc_store_pub/p-300.pdf.

NAVSUP. *Transitions Joint Basing Newsletter.* Issue 2, August 2009. https://www.navsup.navy.mil/navsup/ourteam/navsupgls/navsupflcph/command_activities/jbphh/Transistions-2_14Aug09.pdf.

Navy Fleet Management Plan. (n.d.). https://portal.navfac.navy.mil/portal/page/portal/navfac/navfac_ww_pp/navfac_hq_pp/navfac_pw_pp/vam/fleet%20management%20report%202012_0.pdf.

OPNAV Instruction 11240.8H. "Management of Civil Engineering Support Equipment in the Navy." June 18, 2008. http://doni.daps.dla.mil/Directives/11000%20Facilities%20and%20Land%20Man agement%20Ashore/11- 200%20Transportation%20Facilities,%20Heavy%20Equipment/11240.8H.pdf.

Ratto, Roberto Quintas. *An Analysis of Adopting RFID in the Brazilian Air Force Uniform Sales*. Master's thesis, Naval Postgraduate School, 2011.

Sakata, Masayo. "A Cost Frontier Approach for Estimating the Determinants of Cost Inefficiency in Japanese Fire Protection Management." *Journal of Asian Economics* 15, no. 3 (July 10, 2004): 579–590. http://www.sciencedirect.com/science/article/pii/S1049007804000600obtained 4 June 2012.

Senol Kurt, and Erkan Sonmezocak. "Optimal Route Planning and Scheduling for Unmanned Aerial Vehicles." December 2008. http://hdl.handle.net/10945/3831.

Simmons, Gregory S. "A Study of the Comparability of Naval Activity Motor Vehicle Costs." Master's thesis, Naval Postgraduate School, 1993. http://www.dtic.mil/dtic/tr/fulltext/u2/a268900.pdf.

The TMM*i* Foundation. "Test Maturity Model Integrated (TMMi) for Process Improvement." (n.d.). http://www.tmmifoundation.org/downloads/resources/Whitepaper.Accenture.201 0.pdf.

U.S. Army Installation Management Agency. "Common Levels of Support (CLS) Glossary (Updated 01/06/06)." (n.d.). http://www.ima.army.mil/southeast/sites/divisions/documents/CLS_Glossary.doc.

U.S. Government Accountability Office. *Federal Acquisition. Increased Attention to Vehicle Fleets Could Result in Savings* (GAO-04-664). Washington, DC: GPO, 2004. http://www.gao.gov/new.items/d04664.pdf.

———. *Federal Motor Vehicles, Private and State Practices Can Improve Fleet Management* by William M. Hunt. (GAO/GGD-95-18). Washington, DC: GPO, 1994. http://www.gao.gov/assets/160/154786.pdf.

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